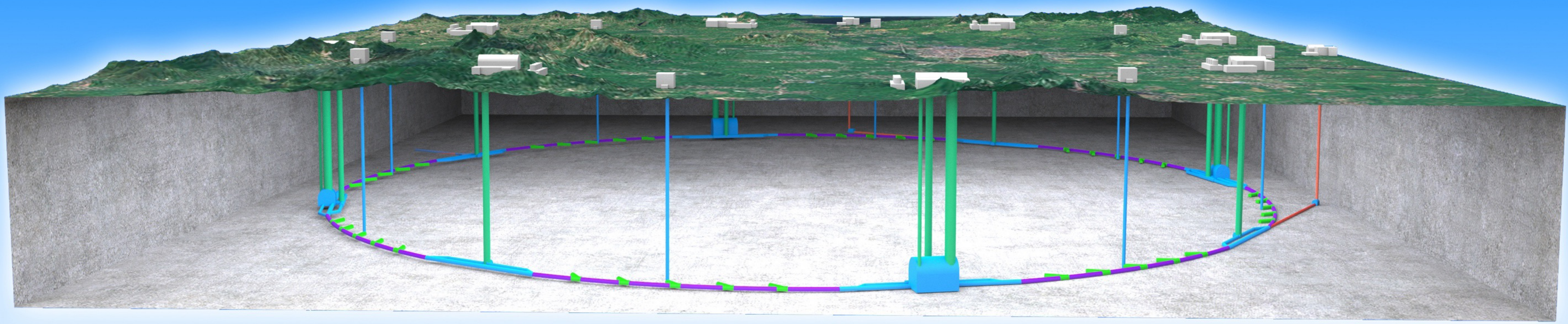
Overview of the Circular Electron Positron Collider



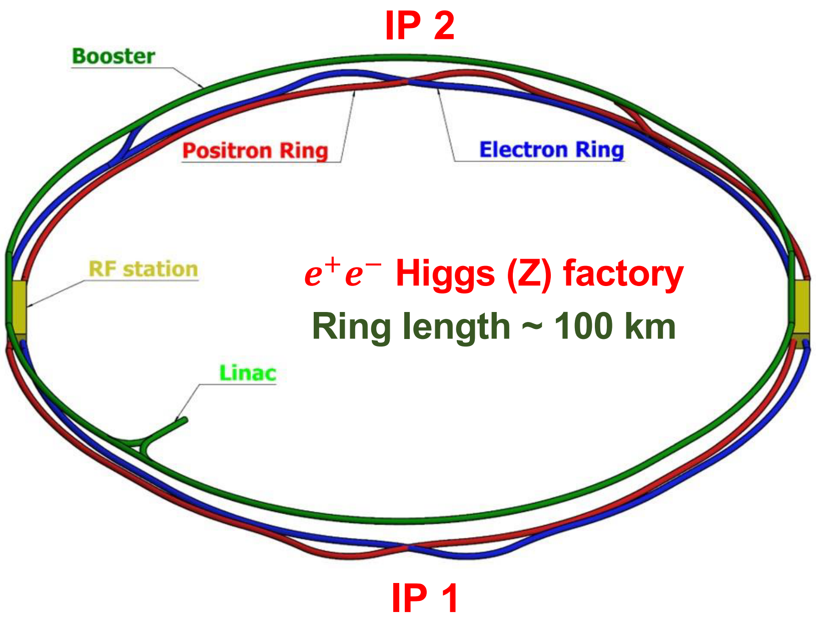
Manqi RUAN(IHEP, Beijing)

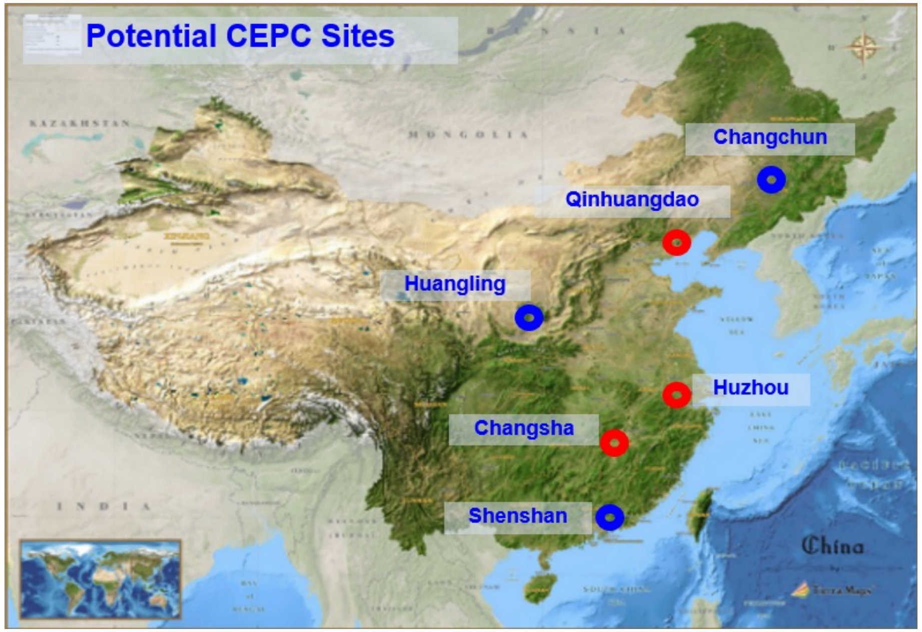
Outline

- Introduction to CEPC
  - Goal and major milestones
  - Consensus on e^+e^- Higgs Factory
- CEPC Status and Progress
  - Physics Program
  - Accelerator R&D
  - Detector R&D
- Project Planning and Development
- Summary

Circular Electron Positron Collider (CEPC)

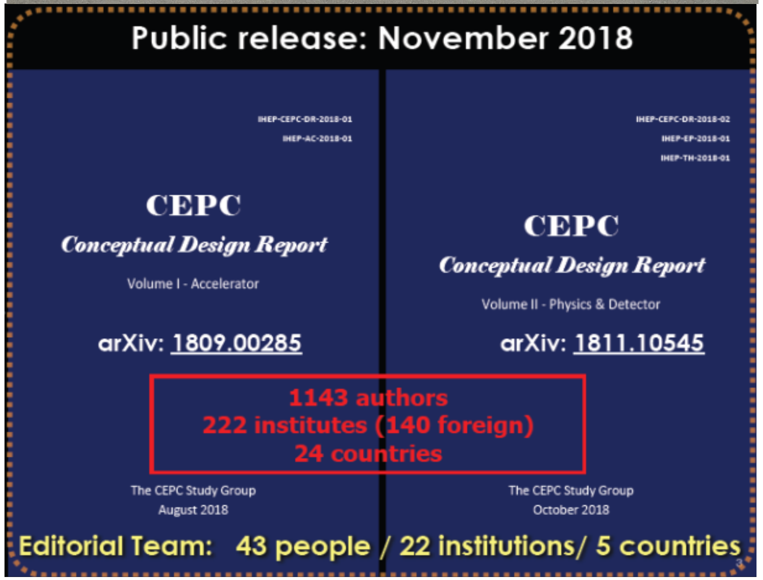
- CEPC is an e^+e^- Higgs factory producing Higgs / W / Z bosons and top quarks, aims at discovering new physics beyond the Standard Model
- Proposed in September 2012 right after the Higgs discovery
- Upgrade: Super pp Collider (SppC) of $\sqrt{s}$ ~ 100 TeV in the future.





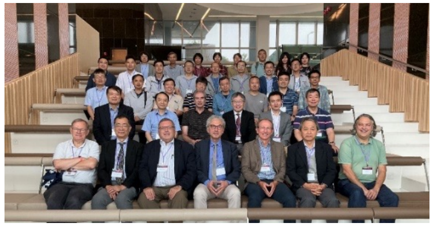
http://cepc.ihep.ac.cn

CEPC Major Milestones

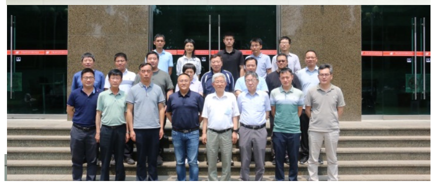


CEPC Major Milestones

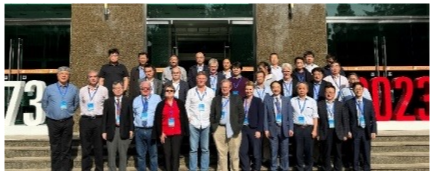
CEPC Accelerator TDR Review
June 12-16, 2023, Hong Kong



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

CEPC Accelerator TDR released in December, 2023

IHEP-CEPC-DR-2023-01

IHEP-AC-2023-01

CEPC

Technical Design Report

Accelerator

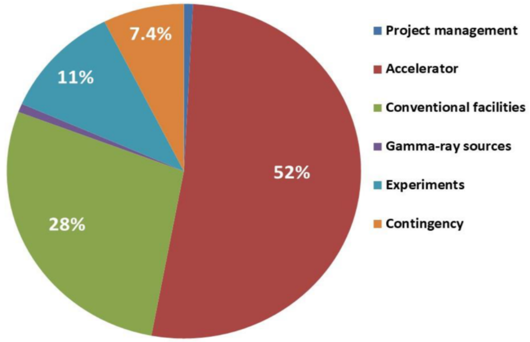
arXiv:2312.14363
1114 authors
278 institutes
(159 foreign institutes)
38 countries

The CEPC Study Group
December 2023

Distribution of CEPC Project **TDR cost** of **36.4B RMB (~4.7B Euro)**

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%



Global HEP Consensus on Higgs Factories

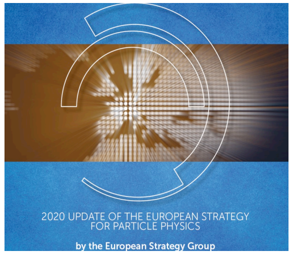
The scientific importance and strategical value of e^+e^- Higgs factories is clearly identified.

China

***2013, 2016**: China Xiangshan Science Conference concluded that **CEPC is the best approach** and a major historical opportunity for the national development of accelerator-based high-energy physics program.*

JAHEP
Japan

2017:** Japan Association of High Energy Physicists (JAHEP) proposes to construct **A 250 GeV center of mass ILC promptly as a Higgs factory.



Europe

***2020:** European Strategy for Particle Physics, **An electron-positron Higgs factory is the highest priority next collider.** For the longer term, the European particle physics community has the ambition to operate a proton-proton collider at the highest achievable energy.*

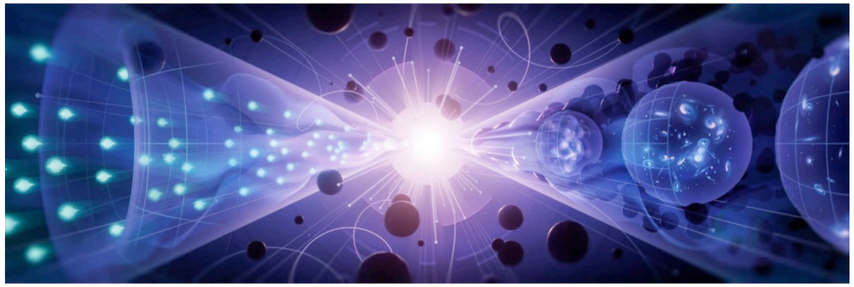
ICFA

***2022**, ICFA "reconfirmed the international consensus on the importance of **a Higgs factory as the highest priority for realizing the scientific goals of particle physics**", and expressed support for the above-mentioned Higgs factory proposals*

Exploring the Quantum Universe

Pathways to Innovation and Discovery in Particle Physics

Report of the Particle Physics Project Prioritization Panel 2023



Exploring the Quantum Universe

Recommendation 6

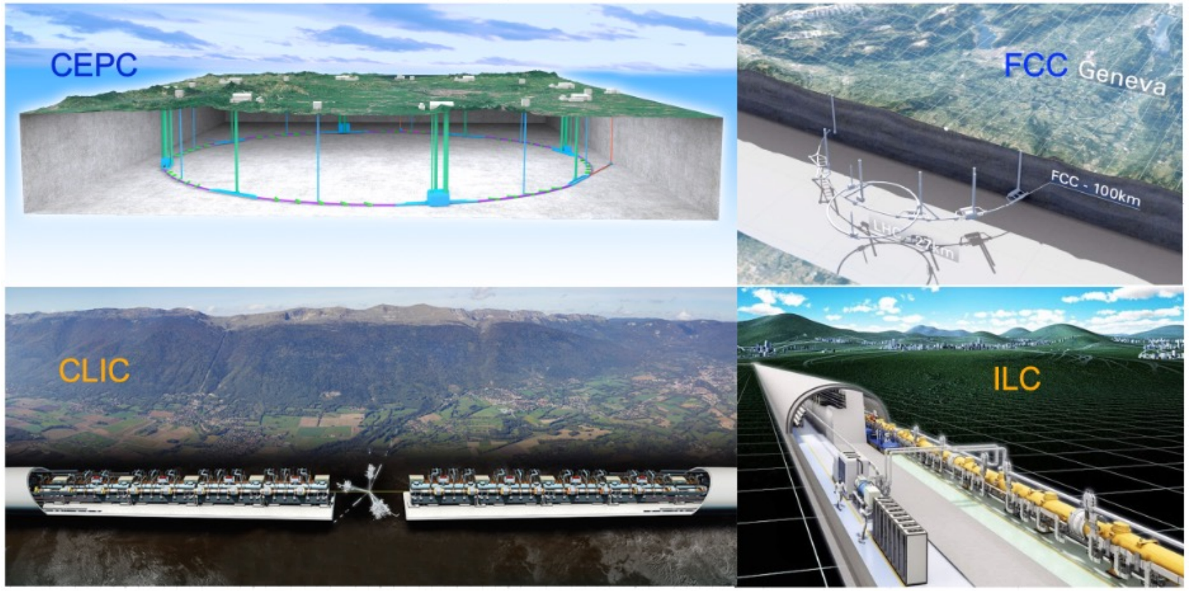
Convene a targeted panel with broad membership across particle physics later this decade that makes decisions on the US accelerator-based program at the time when major decisions concerning an off-shore Higgs factory are expected, and/or significant adjustments within the accelerator-based R&D portfolio are likely to be needed. A plan for the Fermilab accelerator complex consistent with the long-term vision in this report should also be reviewed.

The panel would consider the following:

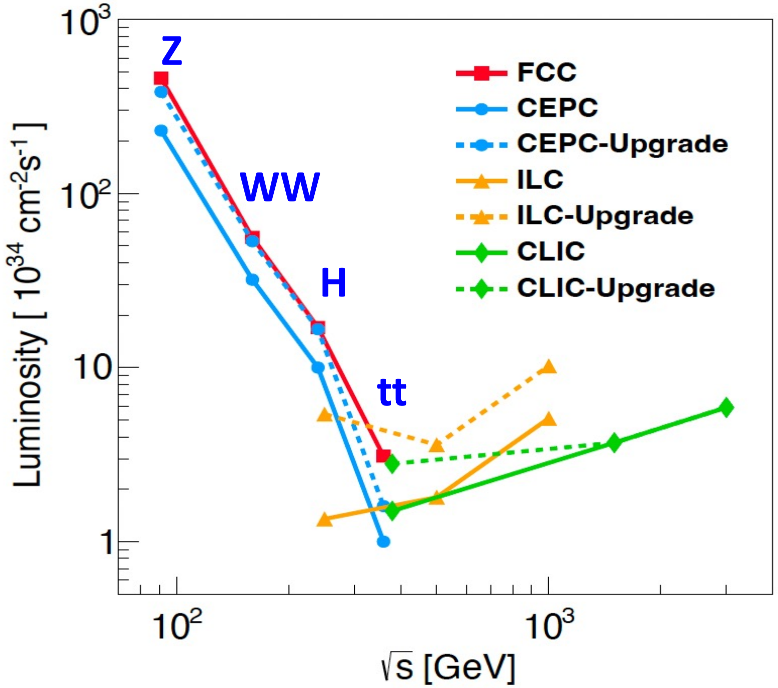
1. The level and nature of US contribution in a specific Higgs factory including an evaluation of the associated schedule, budget, and risks once crucial information becomes available.
2. Mid- and large-scale test and demonstrator facilities in the accelerator and collider R&D portfolios.
3. A plan for the evolution of the Fermilab accelerator complex consistent with the longterm vision in this report, which may commence construction in the event of a more favorable budget situation.

P5 report, USA, 2023

Comparison of Higgs factories: Circular vs Linear



CEPC Accelerator white paper for Snowmass21, arXiv:2203.09451



CEPC has strong advantages among mature e^+e^- Higgs factories (design report delivered)

Versus FCC-ee

- Earlier data: collisions expected in 2030s (vs. ~ 2040s)
- Large tunnel cross section (ee & pp coexistence)
- Lower construction cost

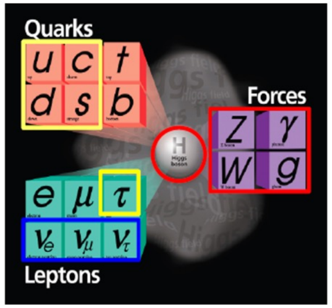
Versus Linear Colliders

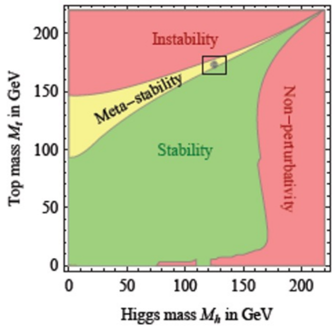
- Higher luminosity / precision for Higgs & Z
- Potential upgrade for pp collider

CEPC Physics Program

- ➢ **Unprecedented precision on Higgs, EW and QCD, rich flavor physics**
- ➢ **Probing new physics up to 10 TeV (direct or indirect)**

- We have a very successful Standard Model
- But we still have a lot of issues and questions:
  - Anything fundamentals behind the flavor symmetry ?
  - Mass hierarchy of elementary particles normal ?
  - Fine tuning of Higgs mass natural ?
  - Why a meta-stable vacuum ?
  - What are dark matter particles ?
  - No CP in the SM to explain Matter-antimatter asymmetry
  - Dirac or Majorana Neutrino mass ?
  - Unification of interactions at a high energy ?
- We are at a turning point:
  - a new, much deeper theory ?
  - Choices of experimental approaches ?
    - e^+e^-, pp, ep, $\mu^+\mu^-$ or no machine ?





- "Small cost" to look for hints. If yes, go for direct searches

$$\mathcal{L} = \mathcal{L}_{SM} + \sum_i \frac{c_i}{M^2}\mathcal{O}_{6,i} \qquad \delta \sim c_i \frac{v^2}{M^2}$$

No signal at LHC:

Direct searches: M ~ 1 TeV

10% precision: M ~ 1 TeV

Look for signals at CEPC/FCC-ee:

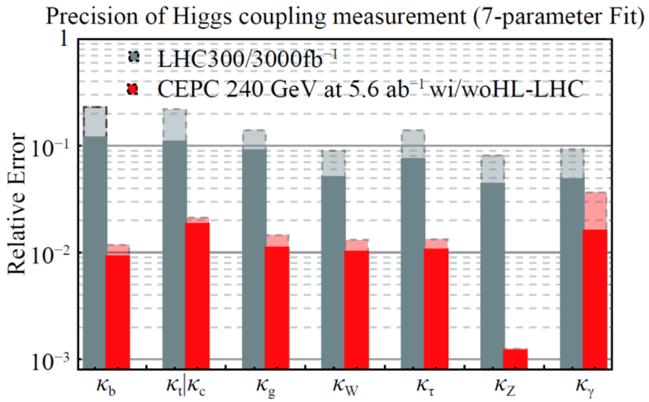
Precisions exceed HL-LHC ~ 1 order of magnitude (1% precision) ➔ M ~10 TeV

New Physics likely < 10 TeV ? ➔ e^+e^- machine
If not, ➔ a 1% machine is valuable even for not-seeing new physics

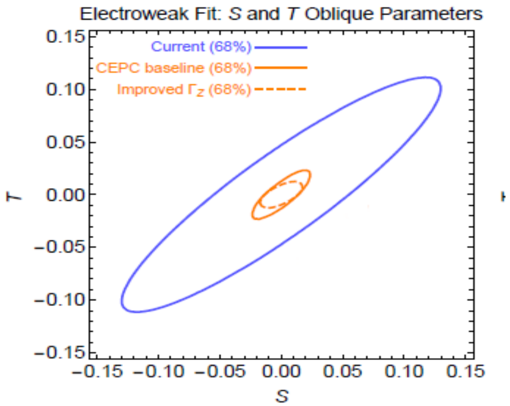
Pressing science questions, best addressed by a Higgs Factory (~1% precision)

CEPC Physics Program: Precision Measurement

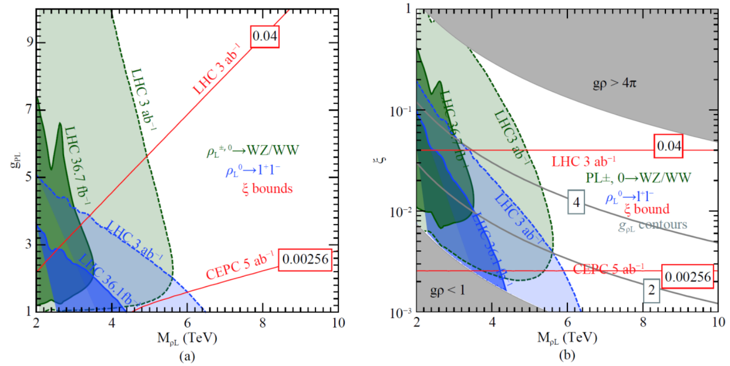
Higgs coupling precision can be improved by an order of magnititude

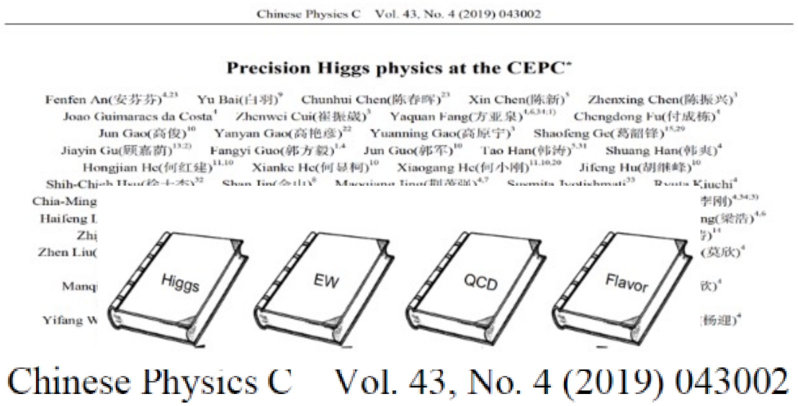


EW measurement can be improved by 1-2 orders of magnitudes

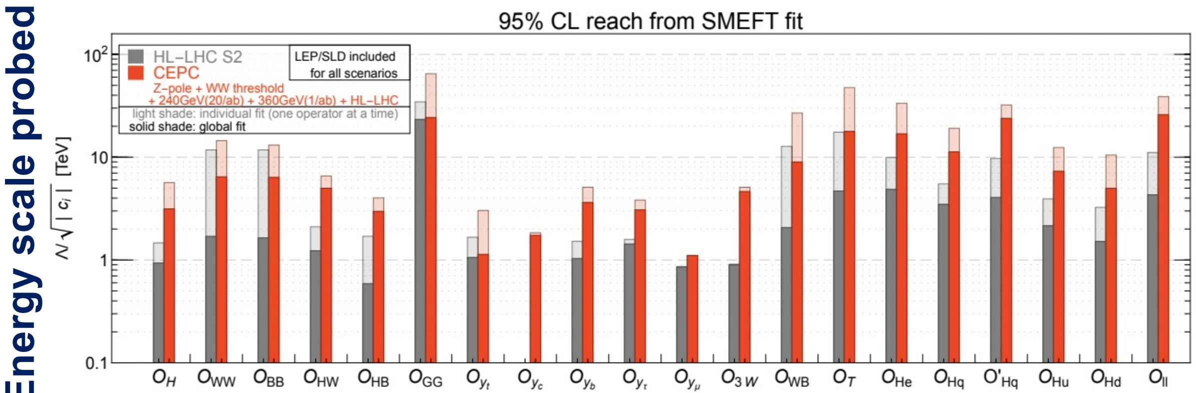


Direct and indirect proble to new physics up to 10 TeV, an order of magntitude higher than the HL-LHC



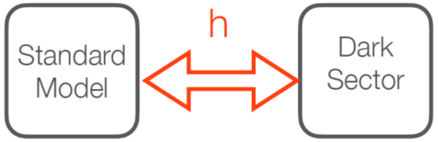


❖ ~ 300 Journal / arXiv papers

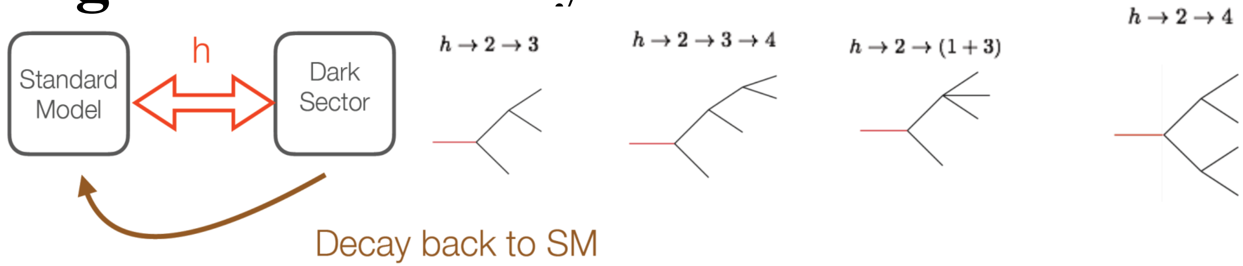


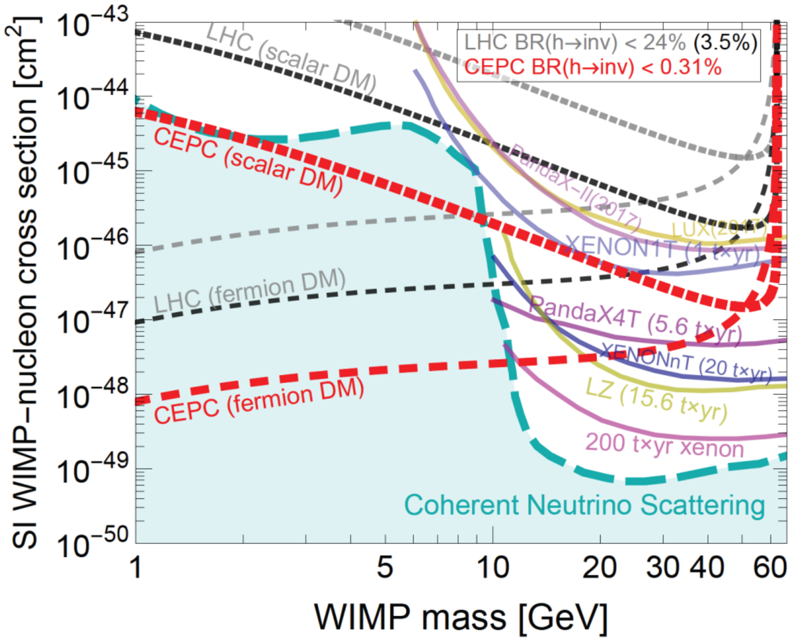
CEPC can reveal new physics at energy ~ 10 TeV or higher

CEPC Physics Program: Discovery Potential

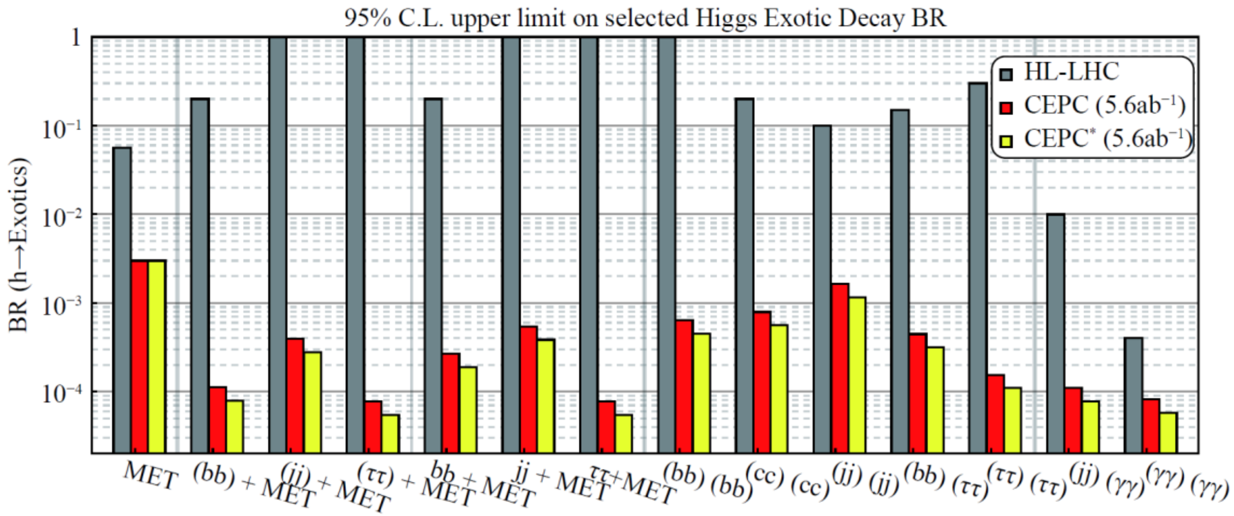


$$h \rightarrow X_{\rm dm} X_{\rm dm}$$





Higgs decays into BSM particles, $H \rightarrow X_1X_2$

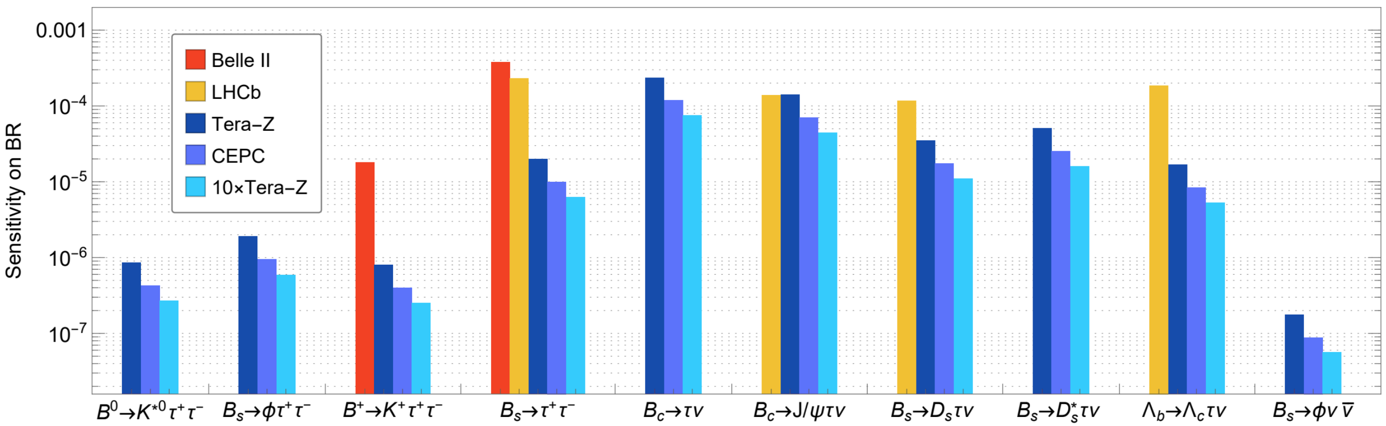


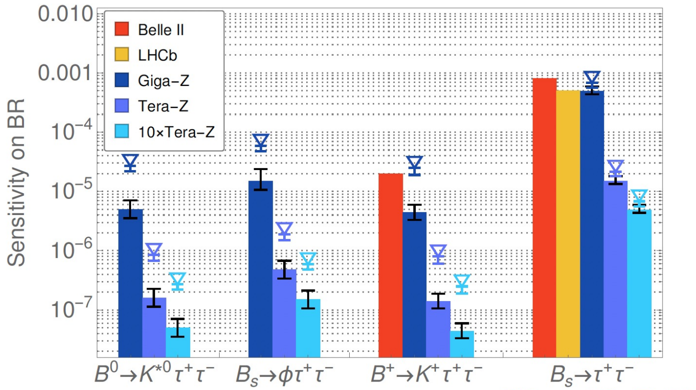
Zhijun Liang's talk

CEPC has significantly better detection sensitivity for dark matter and selected Higgs exotic decays than HL-LHC

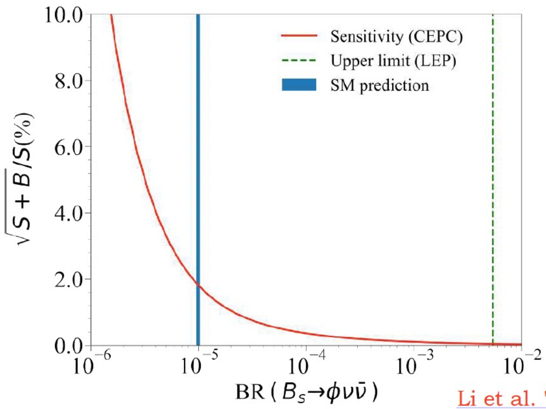
Flavor physics: sensitive to NP with energy scale of 10 TeV or higher

CEPC provides a unique opportunity to study Z LFV decays, rare B decays, tests of LFU in tau decays or Bc decays etc.





Li L. and Liu T. '20



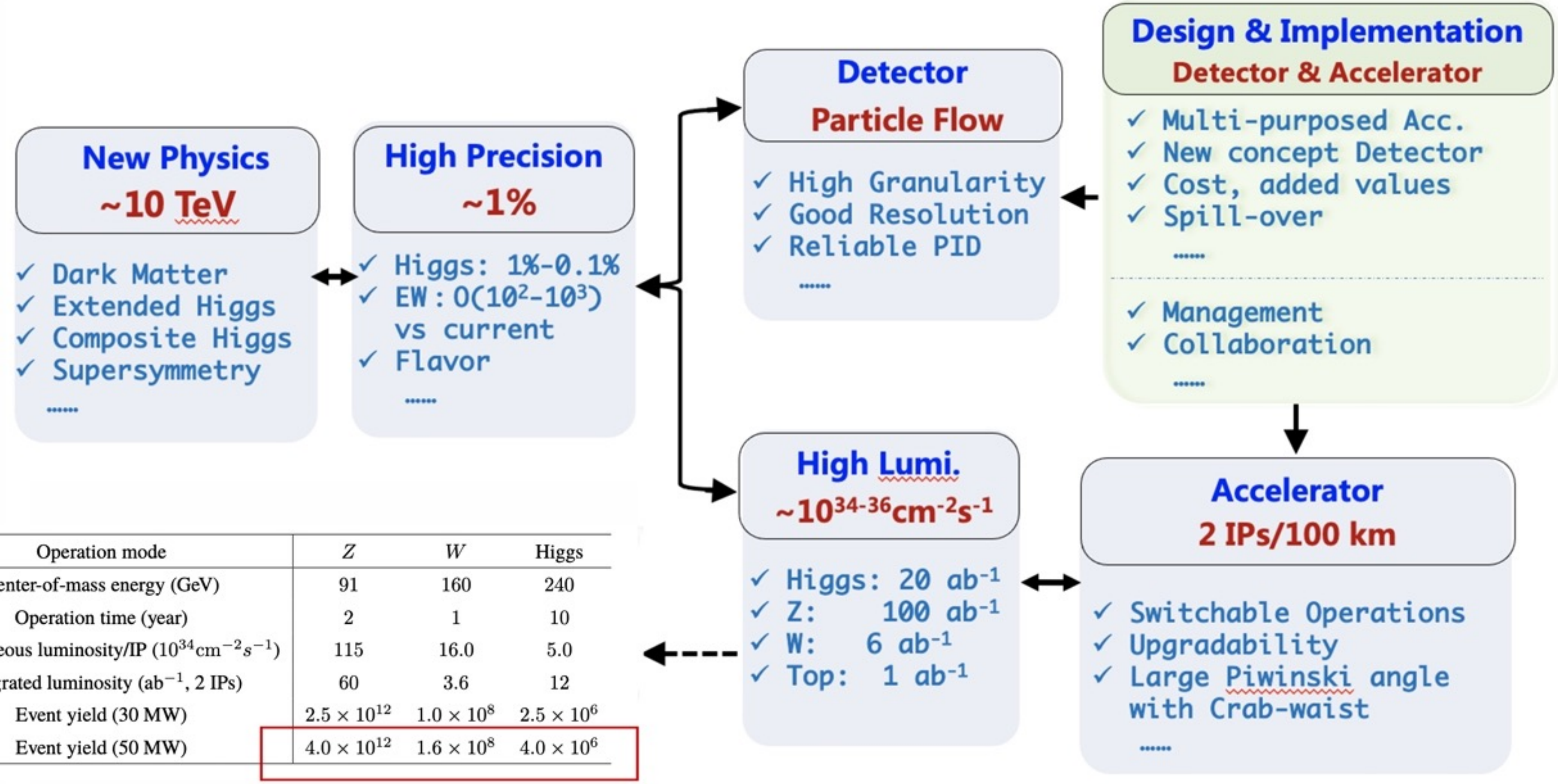
Li et al. '22

Contents

~ 40 Benchmarks

CEPC Concepts

CEPC Key Scientific Issues and Technologies Route

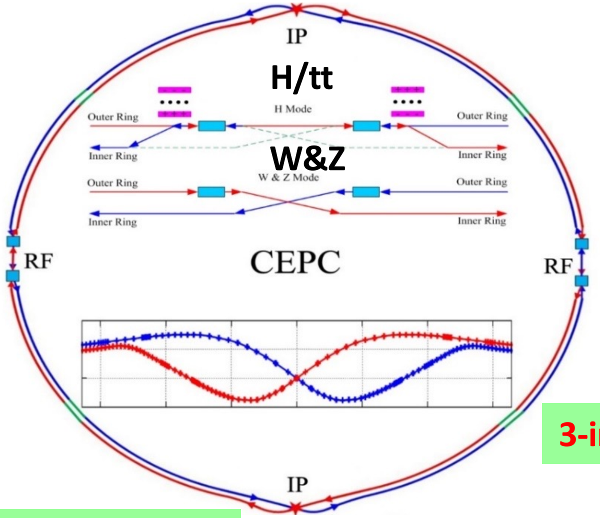


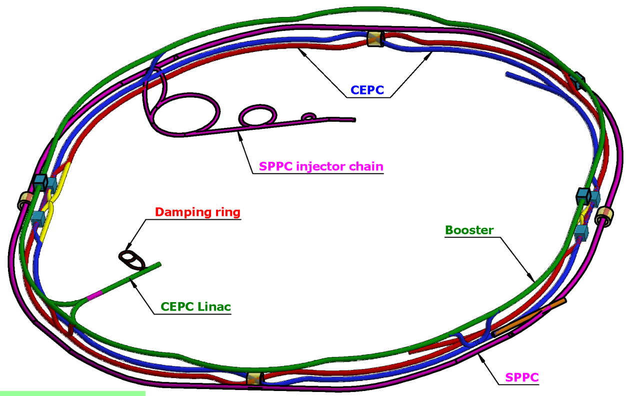
Operation mode	Z	W	Higgs
Center-of-mass energy (GeV)	91	160	240
Operation time (year)	2	1	10
Instantaneous luminosity/IP ($10^{34}\mathrm{cm}^{-2}s^{-1}$)	115	16.0	5.0
Integrated luminosity (ab^{-1}, 2 IPs)	60	3.6	12
Event yield (30 MW)	2.5×10^{12}	1.0×10^{8}	2.5×10^{6}
Event yield (50 MW)	4.0×10^{12}	1.6×10^{8}	4.0×10^{6}

CEPC Accelerator Design and Layout

- 100 km double ring design (30 MW SR, upgradable to 50MW, ttbar)
- Switchable operation for H, Z, W and top modes
- Shared tunnel: compatible design for booster, CEPC and SppC

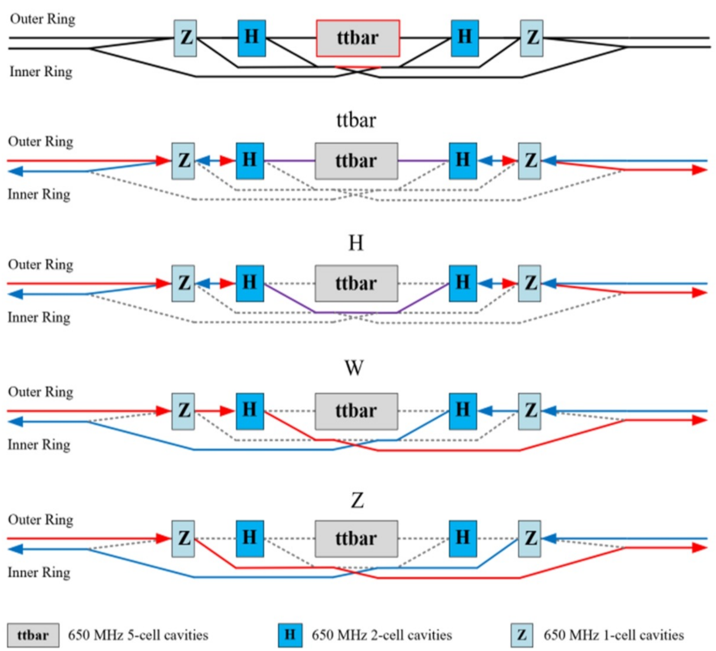
Yuhui Li's talk



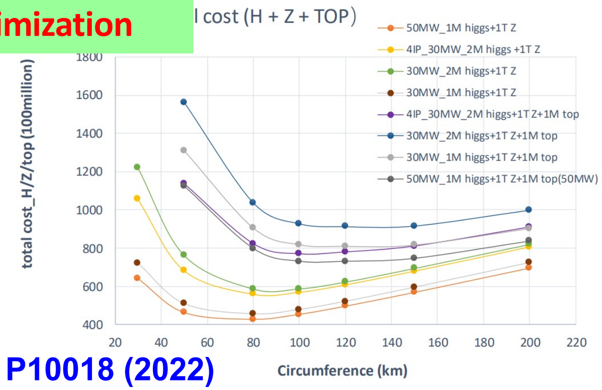


3-in-1 tunnel

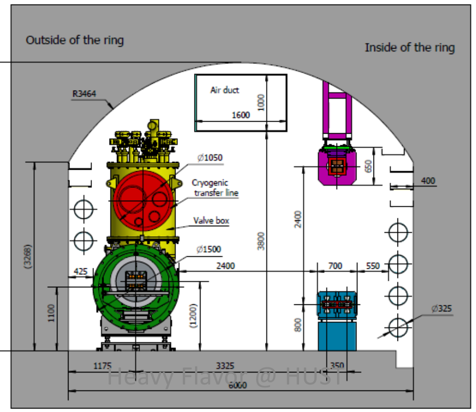
H/W/Z/tt switching operation scheme



Cost optimization



TUNNEL CROSS SECTION OF THE ARC AREA



JINST 17 P10018 (2022)

arXiv:2312.14363

CEPC Operation Plan

Mode	$E_{c.m.}$ (GeV)	Years	SR Power (MW)	Lumi. per IP ($10^{34}cm^{-2}s^{-1}$)	Integrated Lumi. per year (ab^{-1}, 2 IPs)	Total Integrated Lumi (ab^{-1}, 2 IPs)	Total 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

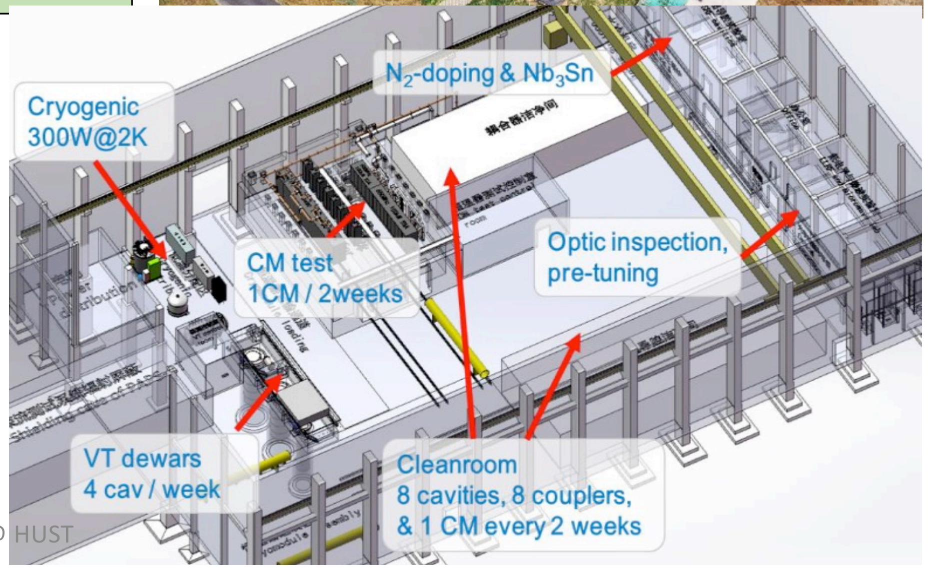
* Higgs is the top priority, the CEPC will commence its operation with a focus on Higgs.

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

*** Calculated using 3,600 hours per year for data collection (~250 days with 60% efficiency).

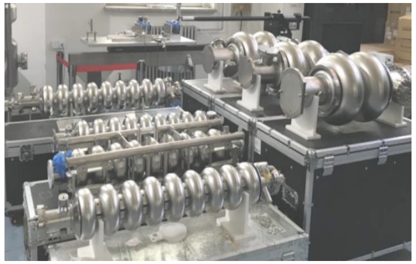
A New Lab: CEPC SRF Test Facility (PAPS)

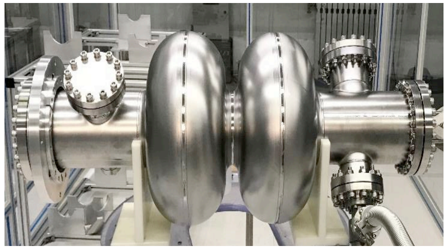
- New Lab (4500m²) at Huairou Beijing, next to HEPS
- A cryogenic system: 2.5KW@4.5K or 300W@2K
- Ovens and clean rooms for cavity production
- 2 horizontal and 3 vertical SRF test stands
- About 200 SRF cavities / year
- Testing of klystrons, electron guns, magnets, etc.,
- NEG coating of vacuum pipes, ATF in the future



CEPC R&D: High Q SRF Cavities

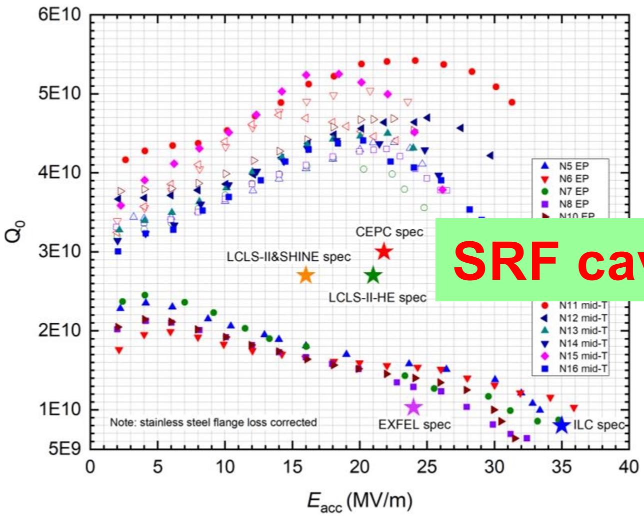
- 1.3 GHz 9-cell SRF cavity for booster: Q_0 = 3.4E10 @ 26.5 MV/m
- 650 MHz 2-cell SRF cavity for collider ring: Q_0 = 6.0E10 @ 22.0 MV/m
- 650 MHz 1-cell SRF cavity for collider ring: Q_0 = 6.0E10 @ 31.0 MV/m

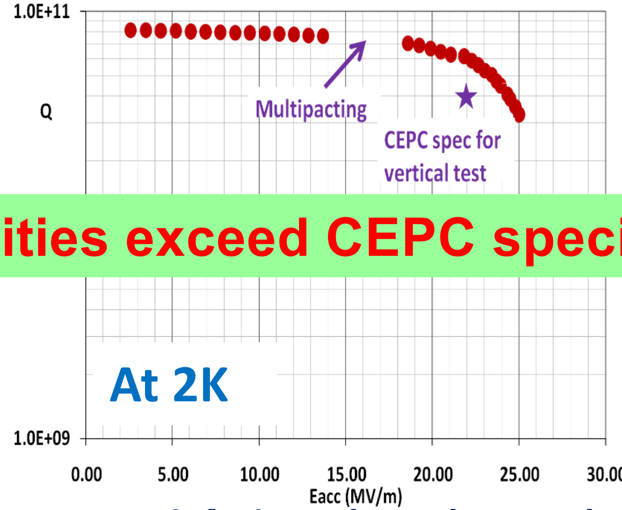


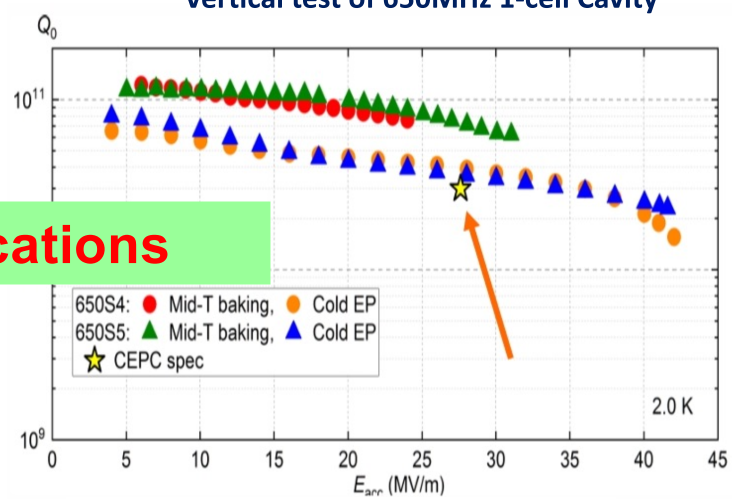


Vertical test of 650 MHz 2-cell cavity

Vertical test of 650MHz 1-cell Cavity







SRF cavities exceed CEPC specifications

Medium-temperature (Mid-T) annealing adopted to reach Q_0 = 3.4E10 @ 26.5 MV/m

N-infusion adopted to reach Q_0 = 6.0E10 @ 22.0 MV/m

Cold-EP and Mid-T baking Q_0 = 6.0E10 @ 31 MV/m

CEPC R&D: 8 × 9-cell High Q Cryomodule

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

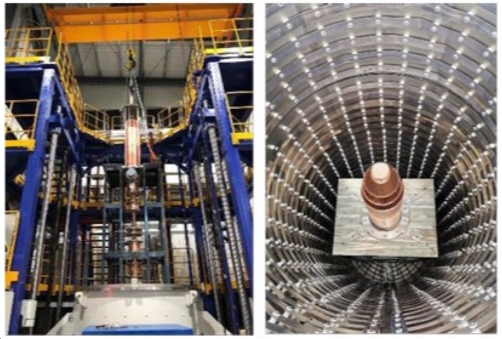
Parameters	Horizontal test results	CEPC Booster Higgs Spec	LCLS-II, SHINE Spec	LCLS-II-HE Spec
Average usable CW E_{acc} (MV/m)	23.1	3.0×10^{10} @ 21.8 MV/m	2.7×10^{10} @ 16 MV/m	2.7×10^{10} @ 20.8 MV/m
Average Q_0 @ 21.8 MV/m	3.4×10^{10}			

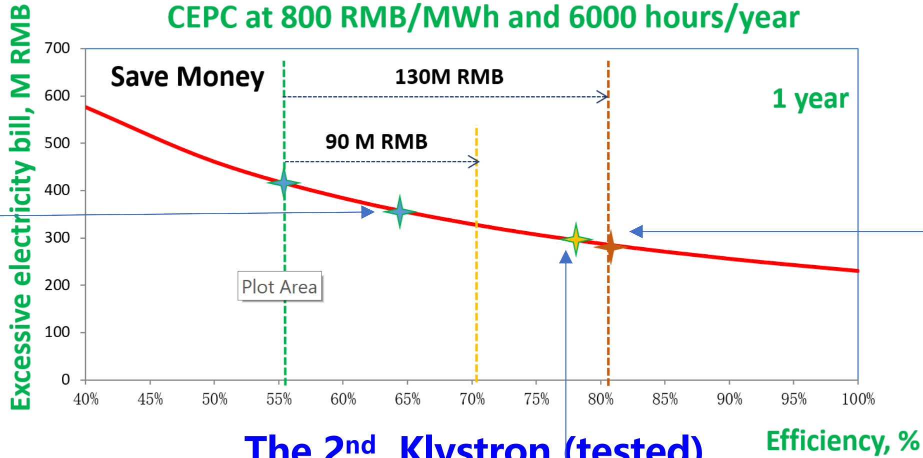
SRF cavities exceed CEPC specifications

CEPC R&D: High Efficiency Klystrons

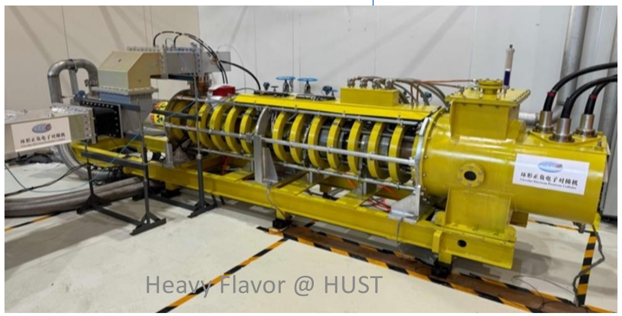
- The 1st Klystron prototype, achieved efficiency ~ 62%
- The 2nd Klystron prototype was tested in Feb. 2024, achieved efficiency ~ 77.2%
- The 3rd Klystron prototype (MBK) with manufacture underway, design efficiency is ~ 80%
- High efficiency Klystron helps to reduce electricity consumption

The 1st Klystron (tested)

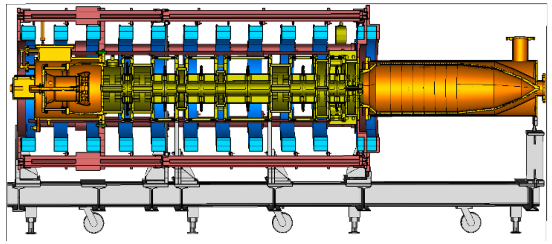


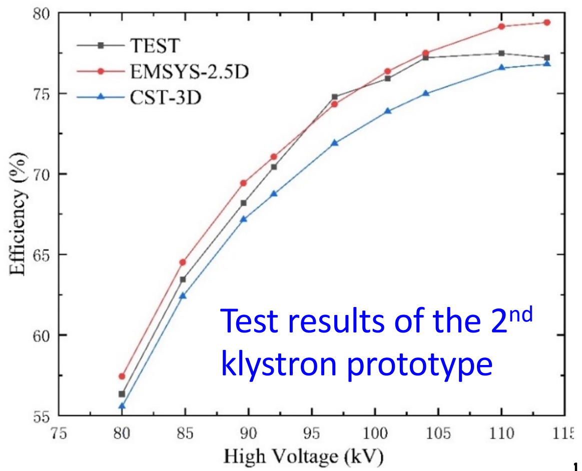


The 2nd Klystron (tested)



The 3rd multi-beam Klystron (MBK) under fabrication

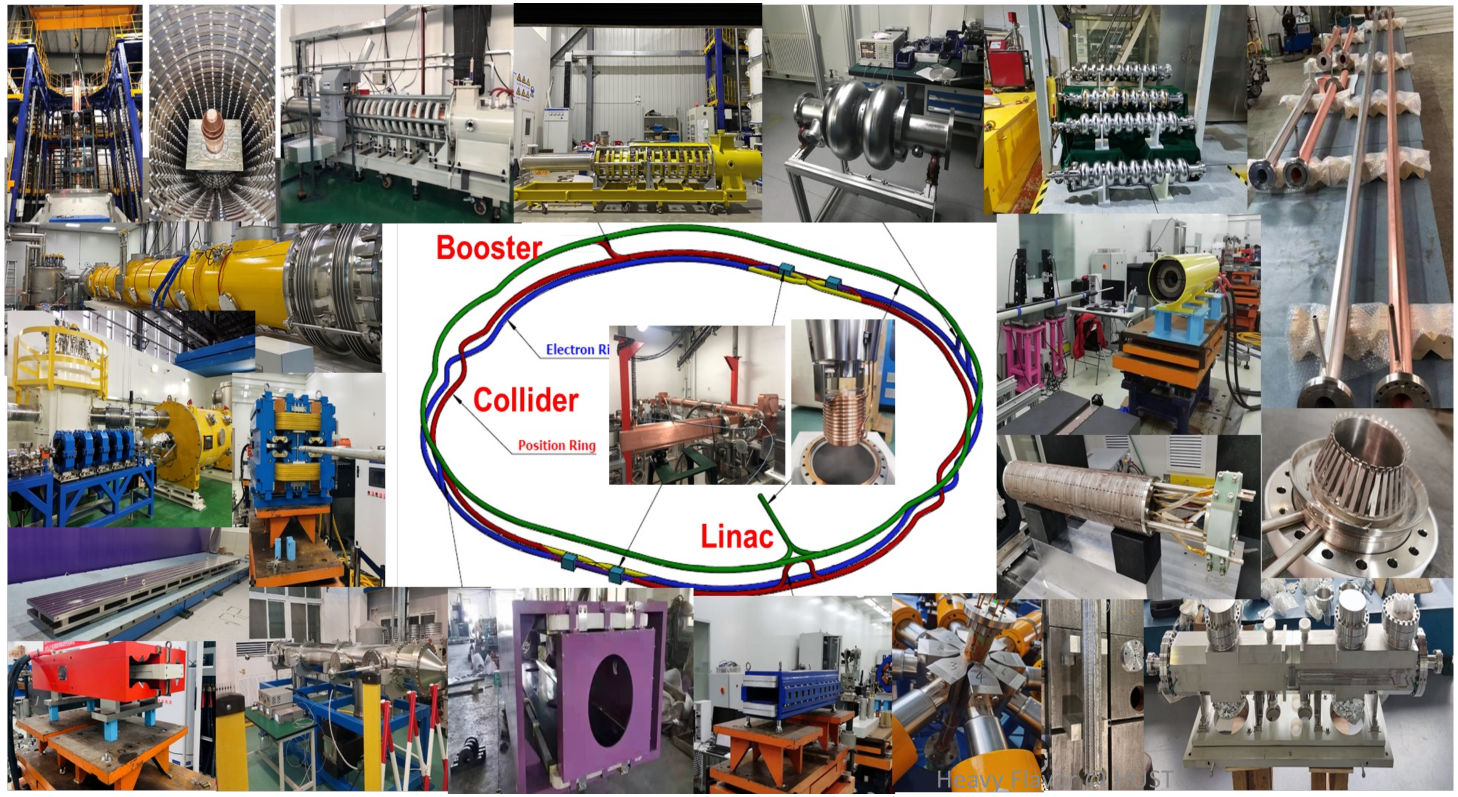




Test results of the 2nd klystron prototype

CEPC R&D: Accelerator Key Technologies

- CEPC accelerator key technologies R&D in TDR covers all component listed in the CDR.
- About 10% remaining (e.g. machine integration, control, alignment, commissioning) to be completed by 2026.

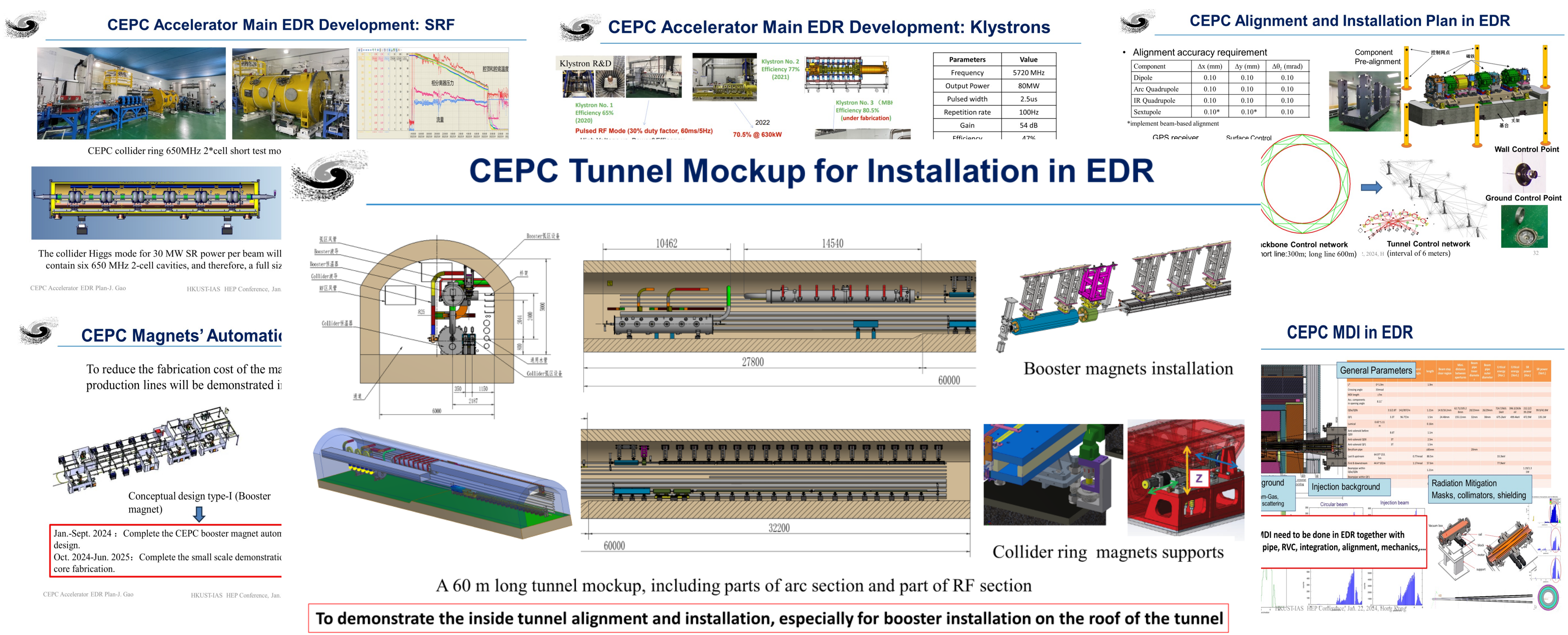


✓ Specification Met
✓ Prototype Manufactured

Accelerator	Ratio
✓ 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%

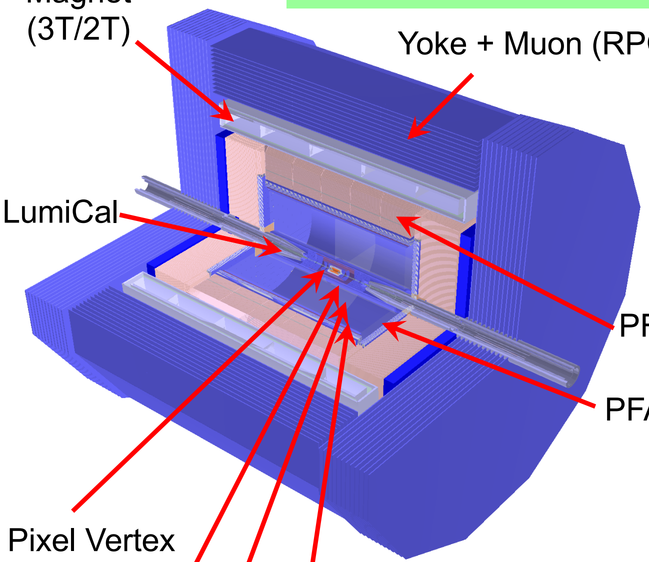
CEPC Accelerator EDR

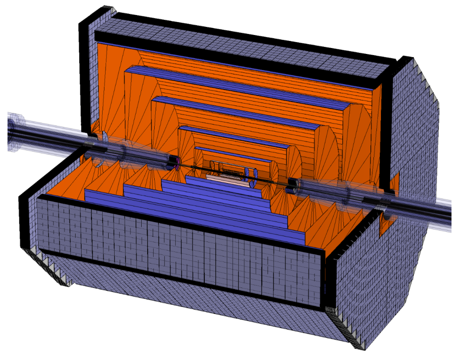
CEPC Accelerator EDR tasks start with 35 WGs aiming for key issues, detailed working plan and scope will be reviewed by IARC in Sept. 2024.



CEPC Conceptual Detector Designs

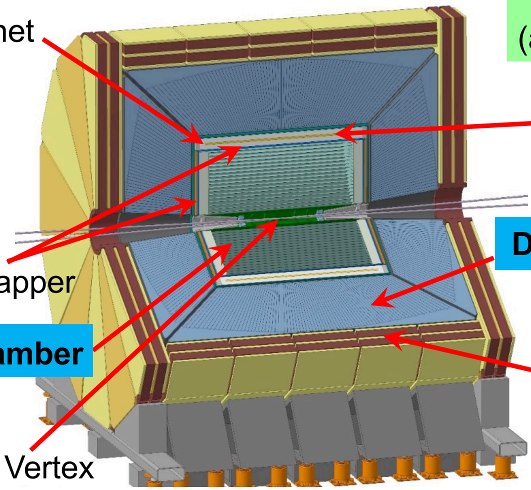
(Baseline Design)
Particle Flow Approach



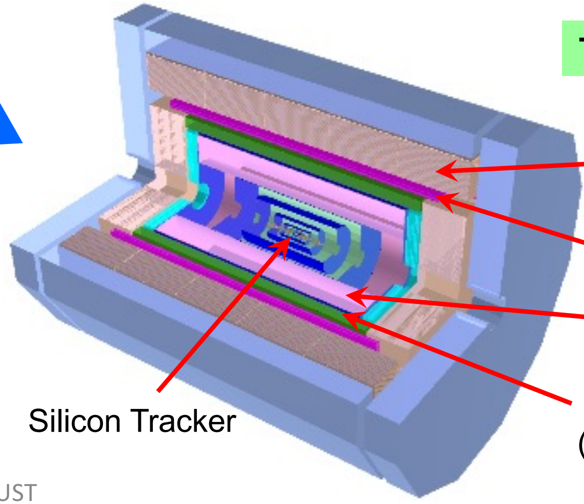


FST concept
(Full Silicon Tracker)

IDEA concept
(also proposed for FCC-ee)



The 4th Concept

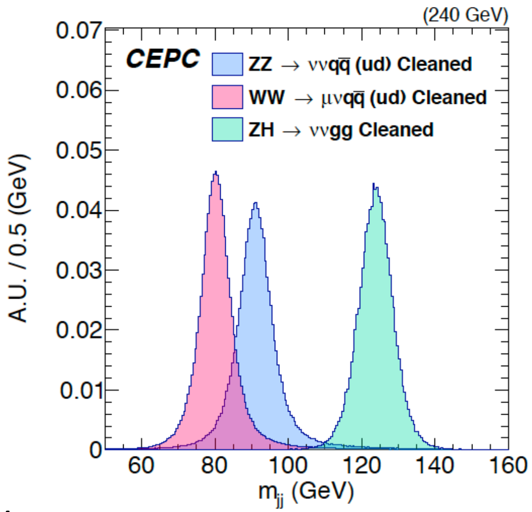


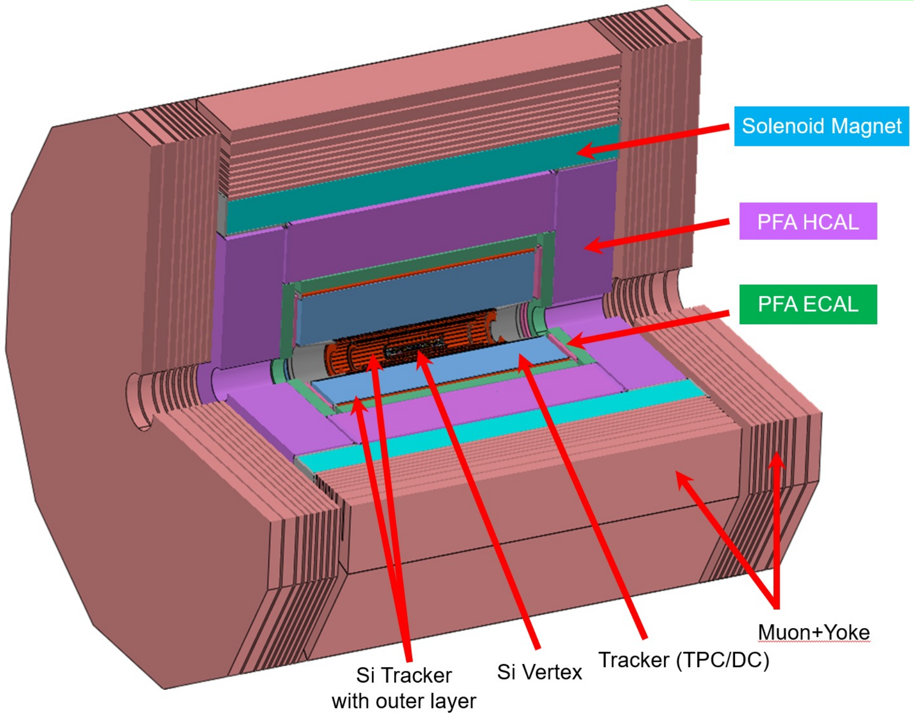
Idea of the "4th Concept"

Zhijun Liang's talk

Novel detector design based on PFA calorimeter. Aim at improving BMR from 4% to 3%

Detector	World-class level	4th concept
PFA based (ECAL)	~ 20% / √E	< 3% / √E
PFA based (HCAL)	~ 50% / √E	~ 40% / √E

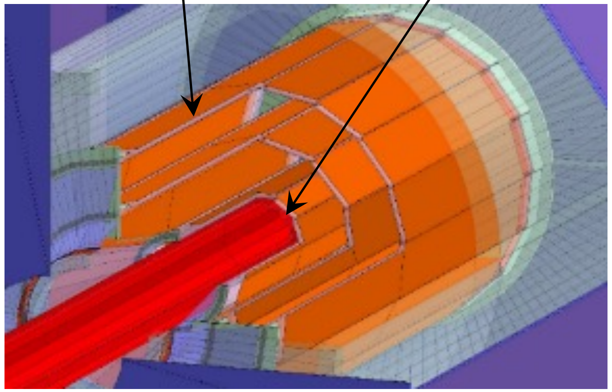




- Silicon combined with TPC or DC for better tracking & PID
- Crystal ECAL with timing for PFA and better EM resolution
- Scintillating glass HCAL for better sampling and resolution

CEPC R&D: Silicon Pixel Chips

2 layers / ladder R_{in}~16 mm



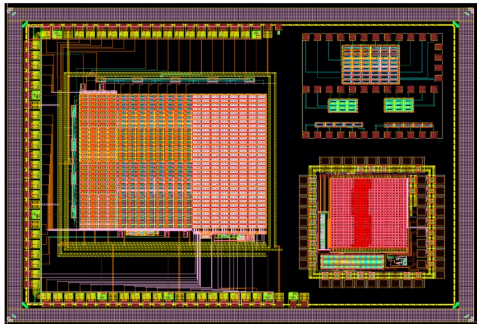
Goal: σ(IP) ~ 5 μm for high P track

CDR design specifications

- **Single point resolution ~ 3μm**
- **Low material (0.15% X_0 / layer)**
- **Low power (< 50 mW/cm^2)**
- **Radiation hard (1 Mrad/year)**

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

Develop **COFFEE** for a CEPC tracker using SMIC 55nm HV-CMOS process

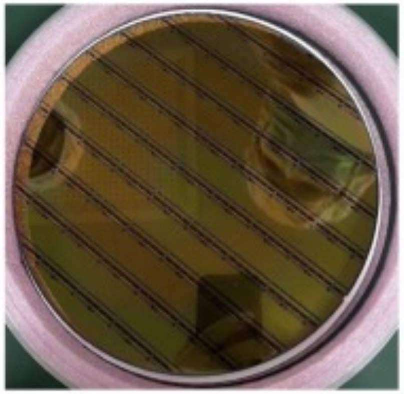


JadePix-3 Pixel size ~16×23 μm^2

Tower-Jazz 180nm CiS process
Resolution 5 microns, 53mW/cm^2

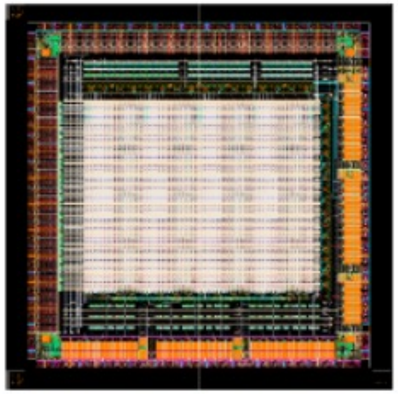
MOST 1

TaichuPix-3, FS 2.5x1.5 cm^2
25×25 μm^2 pixel size

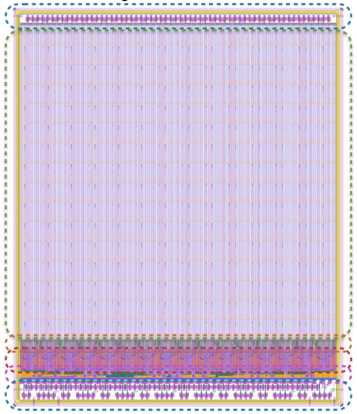


MOST 2

CPV4 (SOI-3D), 64×64 array
~21×17 μm^2 pixel size



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



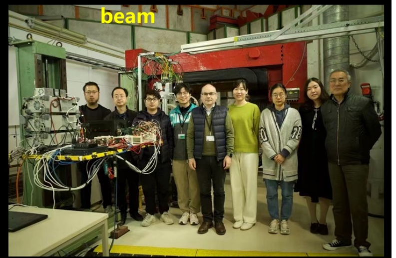
CEPC Detector R&D: Silicon, TPC, DC Prototypes

Test beam @ DESY

- 2nd testbeam: April 11-23 2023 DESY test beam in Germany (4-6 GeV electron)
  - Vertex detector prototype testbeam
- 1st testbeam: Dec 12-22 2022 DESY test beam in Germany (4-6 GeV electron)
  - TaichuPix Beam Telescope testbeam

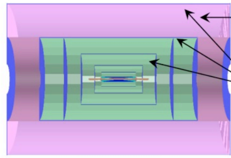
2022 DESY test beam

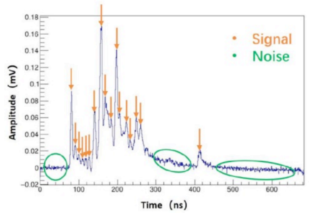
2023 DESY test beam

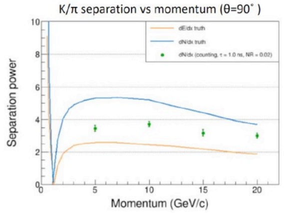


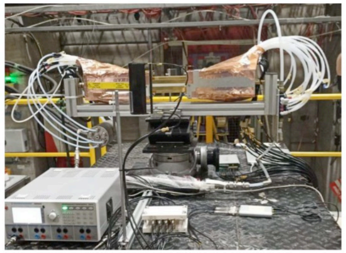
Excellent collaboration with DESY testbeam team

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

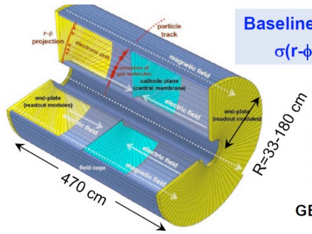




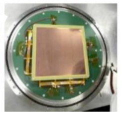




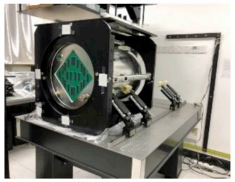
IHEP and Italian INFN groups have close collaboration and regular meetings.
IHEP joined the TB (led by INFN group) in 2021 and 2022



Baseline main tracker
σ(r-ϕ) ~100 μm

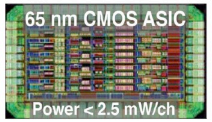


GEM-MM cathode



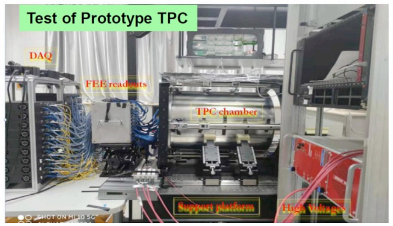
TPC Prototype + UV laser beams

MOST 1 (IHEP+THU)

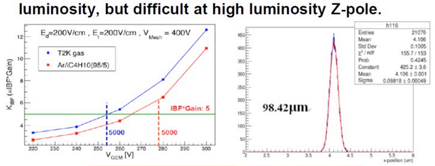


Low power FEE ASIC

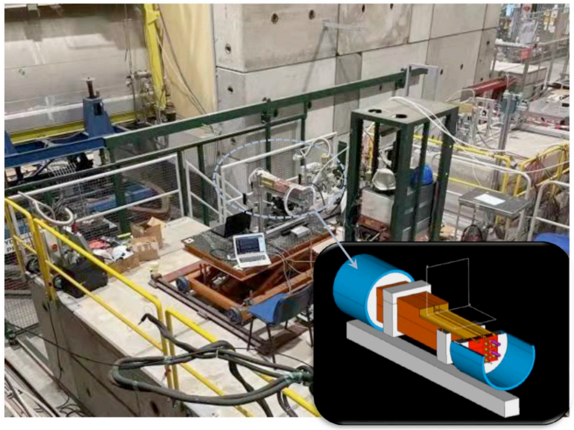
Test of Prototype TPC

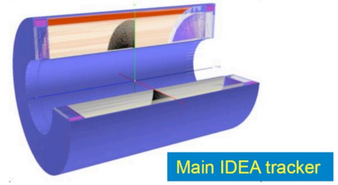


- Challenge: Ion backflow (IBF) affects the resolution. It can be corrected by a laser calibration at low luminosity, but difficult at high luminosity Z-pole.

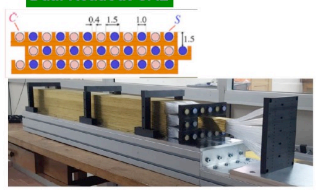


$\sigma_{r\phi}$ < 100 μm for drift length of 27cm





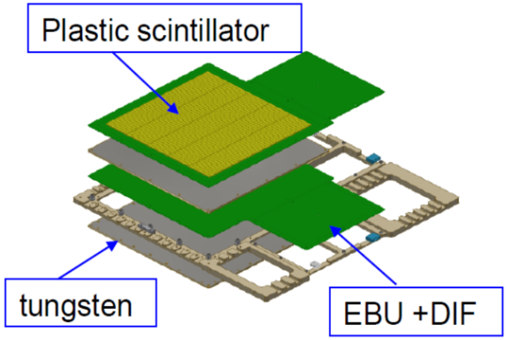
Dual Readout CAL

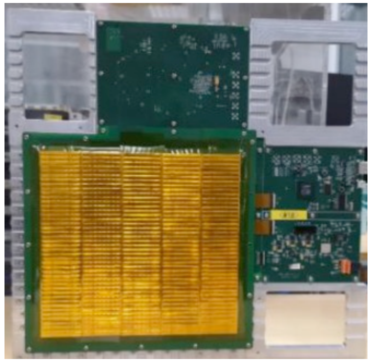


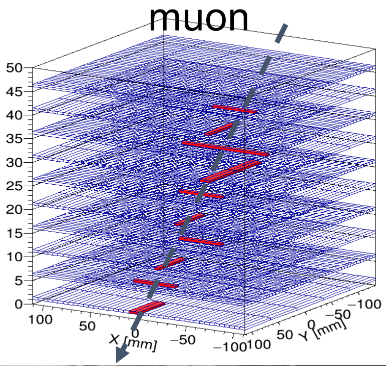
Italian groups and IHEP colleagues participated the test beam at CERN.

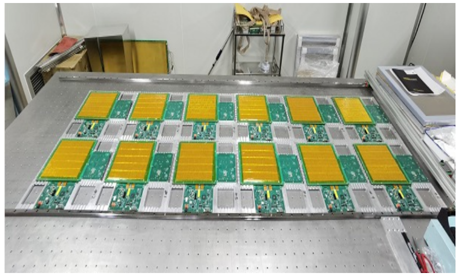
CEPC R&D: PFA Calorimeter Prototypes

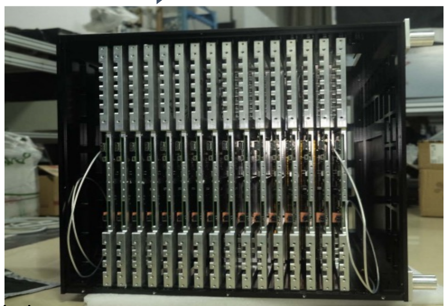
ScW ECAL Prototype (32-layer, 6720-ch)

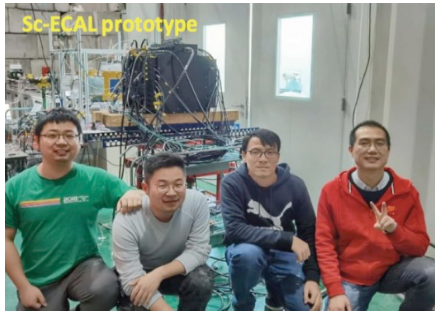




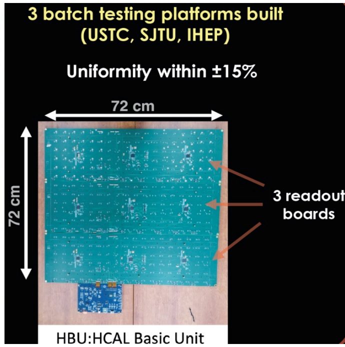


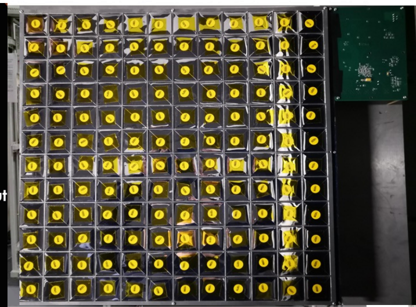






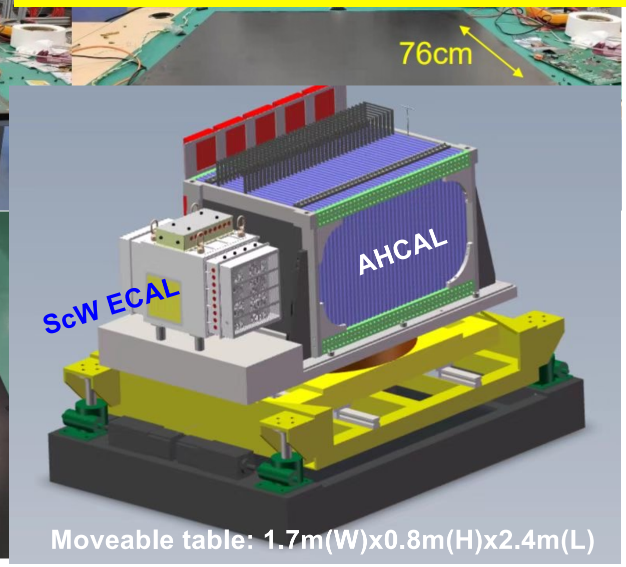
Scintillator + SiPM AHCAL Prototype (40-layer, 12960-ch)




SJTU


IHEP

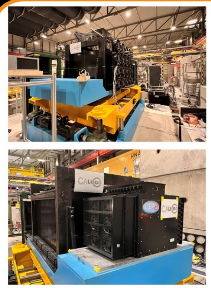
Combined: ScW-ECAL + AHCAL

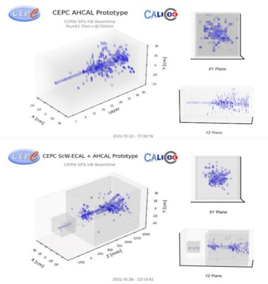


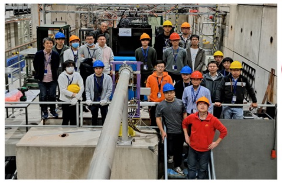
➔ Testbeam at CERN for two prototypes in 2022 and 2023

CEPC Detector R&D: Calorimeter Prototypes

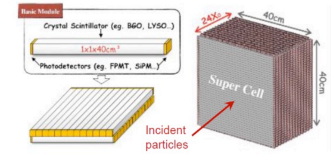
CEPC calorimeter prototypes: beamtest in 2022



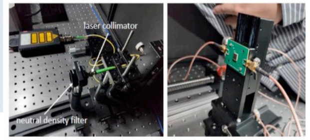




- Successful beamtest at CERN SPS H8: **Oct-Nov, 2022**
  - High energy particle beams: muons, positrons and hadrons (10 - 160 GeV)
  - Suffered from beam purity issue in pion and positron beams



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

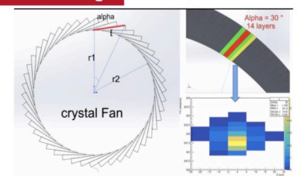


Bench Test

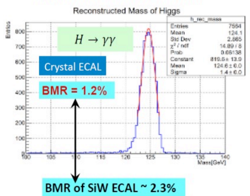
- Long bars: 1 x 40 cm, super-cell: 40x40 cm²
- Timing at both ends for positioning along bar.
- Significant reduction of number of channels.

Full Simulation Studies + Optimizing PFA for crystals

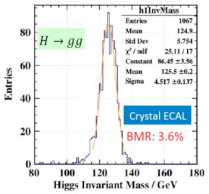
Crystal Fan Design Fine segmentation in Z, ϕ, r



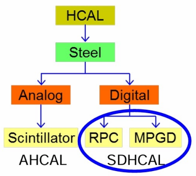
Performance with photons

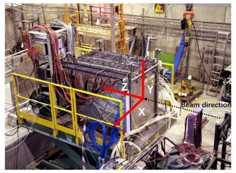


Performance with jets

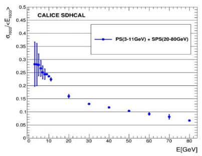


Dual readout crystal calorimeter also being considered by USA and Italian colleagues

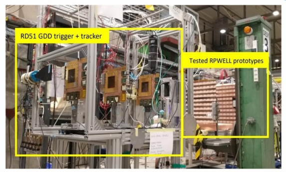




SDHCAL-GRPC (1.3 m³, IPNL)



JINST 15, P10009 (2020)
JINST 17, P07017 (2022)



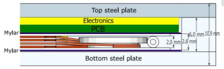
RPWELL (50x50cm², WIS+IIT, Israel)

MOST 1: RPC and MPGD (RWELL) R&D，MIP Eff > 95%

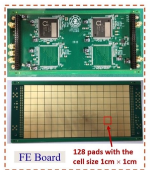
GRPC 1m x 1m (SJTU) RWELL 0.5m x 1m (USTC+IHEP)

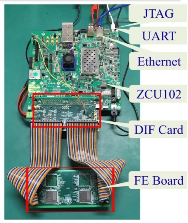
JINST 16, P12022 (2021)

R&D Plan: 5-D SDHCAL (X, Y, Z, E, Time)
- MRPC + fast timing PETIROC ASIC (~40 ps)



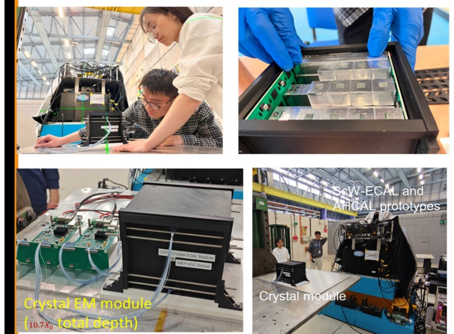
SJTU
IPNL
IJCLab
OMEGA
CIEMAT

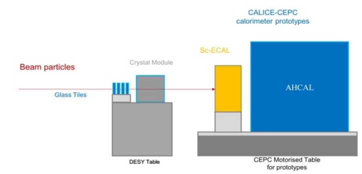




Crystal modules: beamtest at CERN in 2023

- Successful CERN beamtest: parasitic runs at PS-T9 (May 16-23, 2023)

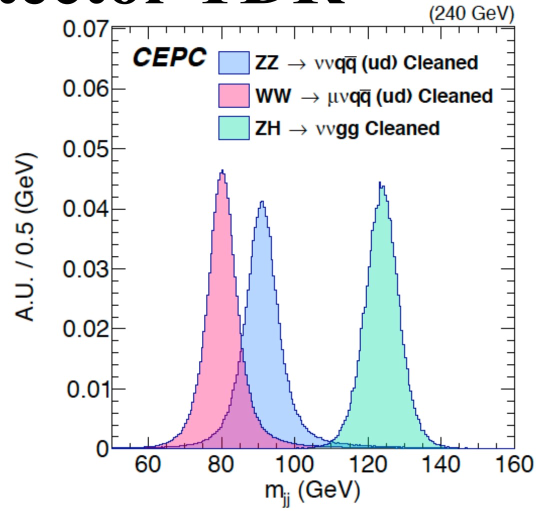


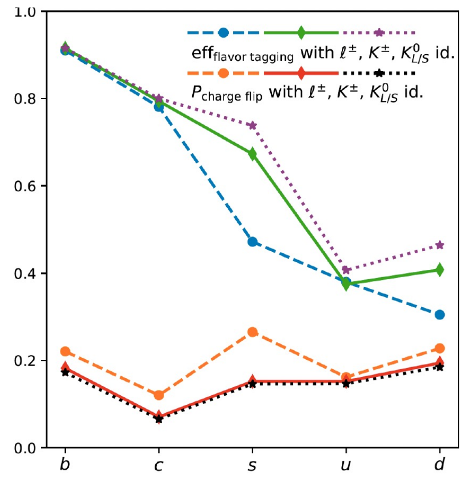


- Achieved major goals
  - Commissioning of the first crystal module
  - Validation of simulation and digitization

Physics Benchmarks towards the Ref. Detector TDR

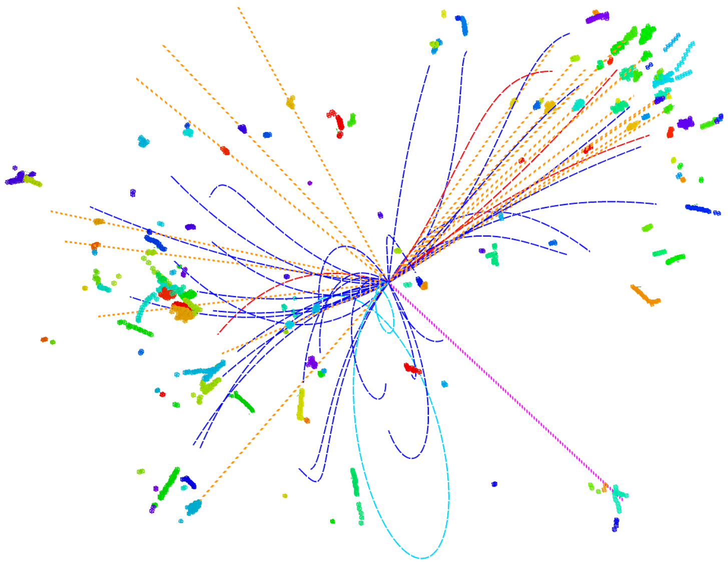
	Processes @ c.m.s.	Domain	Total Det. Performance	Sub-D
H->ss/cc/sb	vvH @ 240 GeV	Higgs	PFA + JOI (Jet origin id)	All sub-D, especially VTX
H->inv	qqH	Higgs/NP	PFA	All
Vcb	WW@ 240/160 GeV	Flavor	JOI + Particle (lepton) id	All
W fusion Xsec	vvH @ 360 GeV	Higgs	PFA + JOI	All
α_S	Z->tautau @ 91.2 GeV	QCD	PFA: Tau & Tau final state id	ECAL + Tracker material
B->DK	91.2 GeV	Flavor	PFA + Particle (Kaon) id	All, especially Tracker & ToF
Weak mixing angle	Z	EW	JOI	All
Higgs recoil	llH	Higgs	Leptons id, track dP/P	Tracker, All
H->bb, cc, gg	vvH	Higgs	PFA + JOI	All
	qqH	Higgs	PFA + JOI + Color Singlet id	All
H->di muon	qqH	Higgs	PFA, Leptons id	Calo, All
H->di photon	qqH	Higgs	PFA, Photons id	ECAL, All
W mass & Width	WW@160 GeV	EW	Beam energy	NAN
Top mass & Width	ttbar@360 GeV	EW	Beam energy	NAN
Bs->vvPhi	Z	Flavor	Object in jets; MET	All
Bc->tauv	Z	Flavor	-	All
B0->2 pi0	Z	Flavor	Particle/pi-0 in jets	ECAL

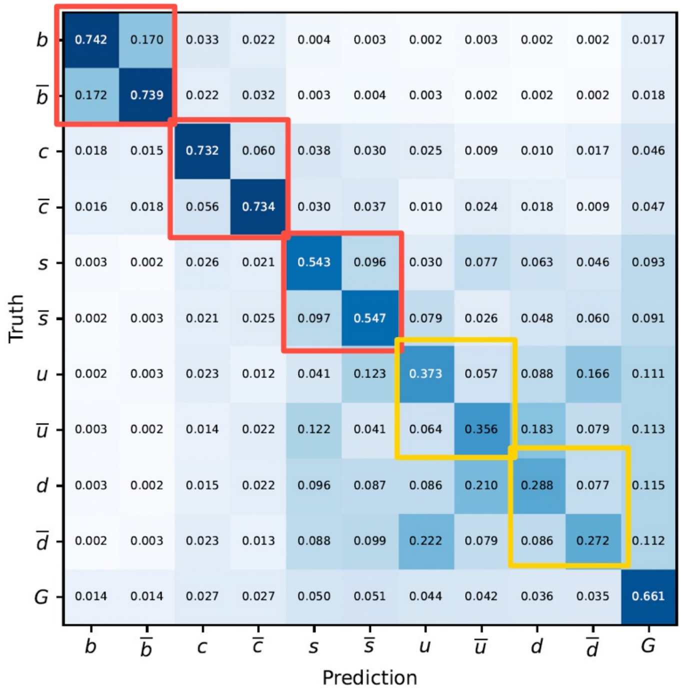


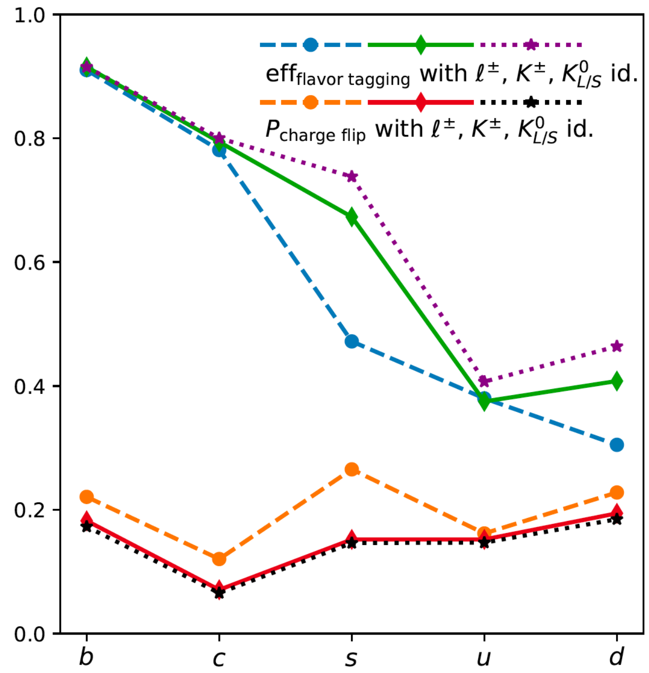


Jet origin identification: concept & realization

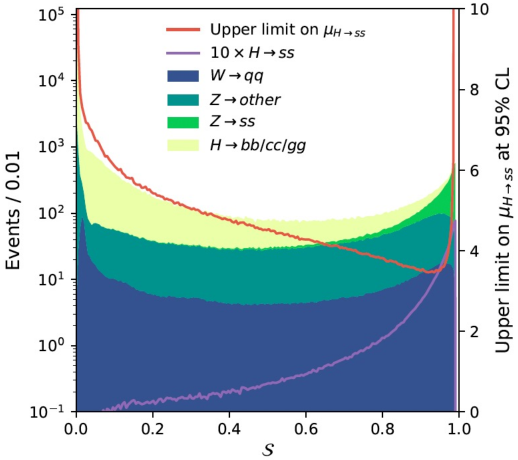
- Jet origin identification: 11 categories (5 quarks + 5 anti quarks + gluon)
  - Jet Flavor Tagging + Jet Charge measurements + s-tagging + gluon tagging…
- Realization: PFA algorithm Arbor + ParticleNet (Deep Learning Tech.)

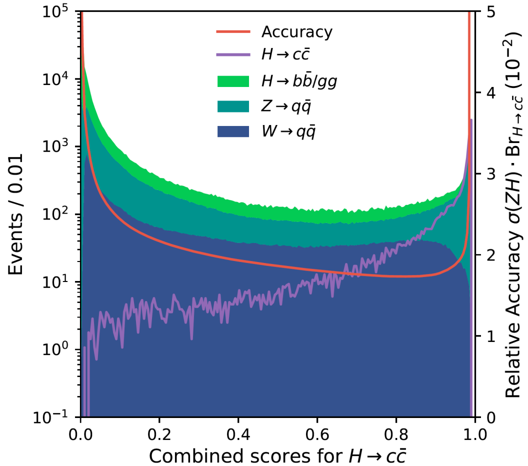


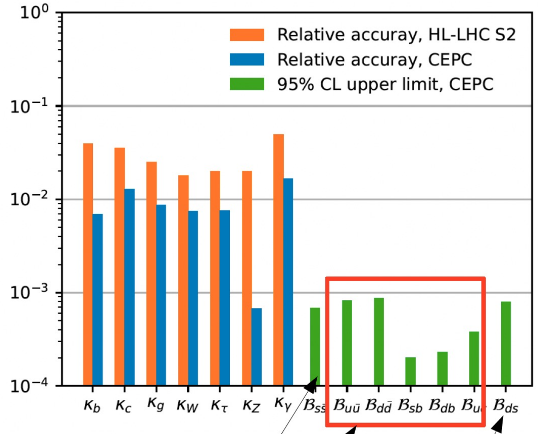




Jet origin identification: impact



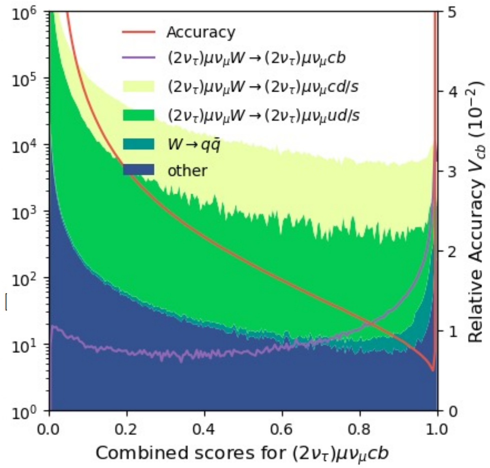




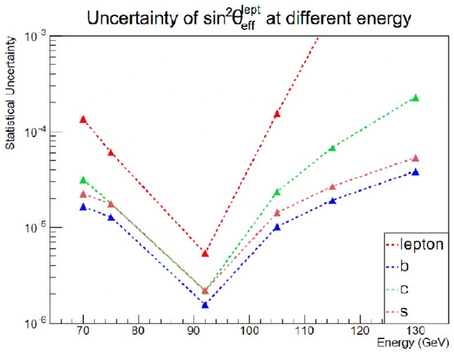
Improved by ~3 times

Improved by 1-2 orders of magnitudes

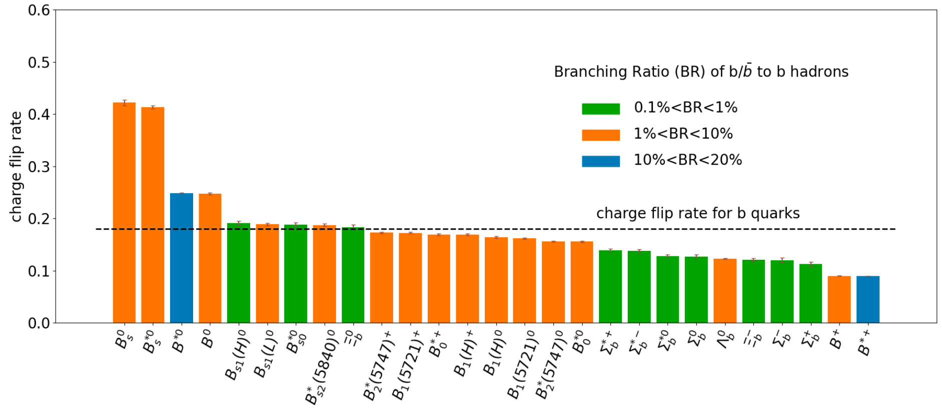
Presumably... firstly quantified



Expected statistical uncertainties on $\sin^2\theta^l_{eff}$ measurement.
(Using one-month data collection, ~ $4e12/24$ Z $events$ at Z pole)



$\sqrt{s}$	b	c	s
70	1.6×10^{-5}	3.2×10^{-5}	2.2×10^{-5}
75	1.3×10^{-5}	1.8×10^{-5}	1.8×10^{-5}
92	1.6×10^{-6}	2.2×10^{-6}	2.2×10^{-6}
105	1.0×10^{-5}	2.4×10^{-5}	1.4×10^{-5}
115	1.9×10^{-5}	6.8×10^{-5}	2.7×10^{-5}
130	3.9×10^{-5}	2.3×10^{-4}	5.4×10^{-5}

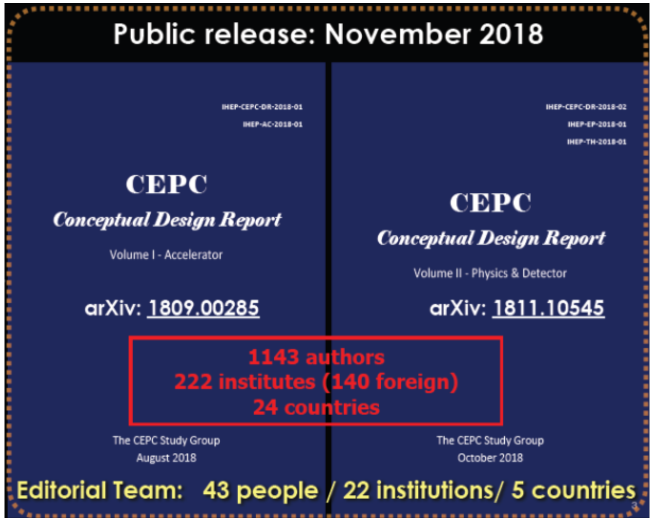


CEPC International Collaboration

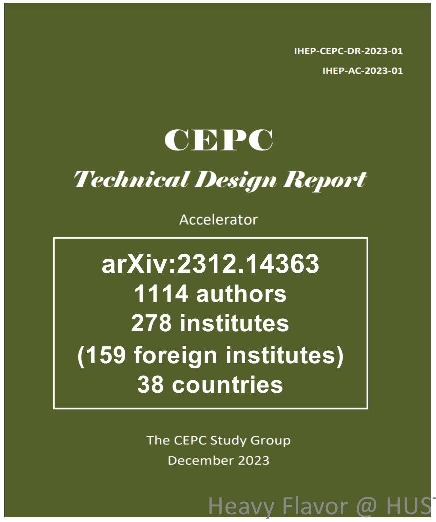
CEPC attracts significant International participation

- Both CDR and TDR have significant intl. contributions
- 20+ MoUs signed with Intl. institutions and universities
- CEPC International Workshop since 2014
- EU-US versions of CEPC Workshop since 2018
- Annual working month at HKUST-IAS since 2015

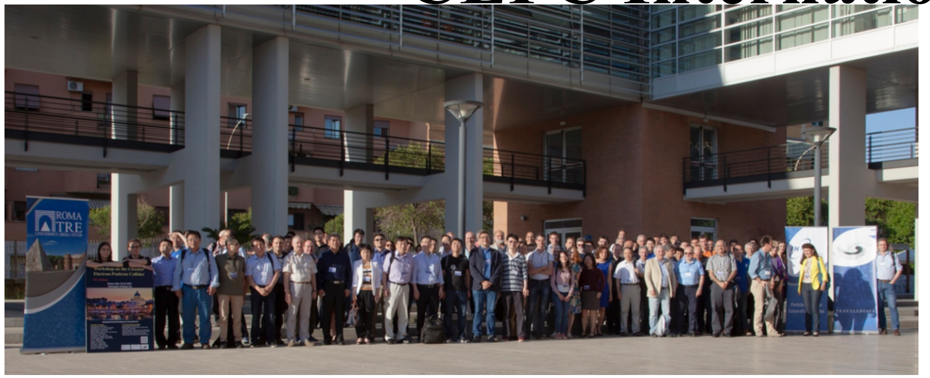
CEPC CDR released (2018)



CEPC TDR released (2023)



CEPC International Collaboration



[CEPC @ Rome, Italy](), May 2018

[CEPC @ Oxford, UK](), April 2019

[CEPC @ Edinburgh, UK](), July 2023

[CEPC @ U. Chicago, USA](), Sept. 2019
[CEPC @ Washington DC, USA](), April 2020

Industrial Partners and Suppliers 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)

LEIKE 雷科电子, KAITENG SIFANG, BBEF 北广科技, VACREE, TOLY ELECTRIC 通力电工, PUSU, 高能锐新 HE-RACING TECHNOLOGY, 上海超导, 地矿建设 DIKUANG CONSTRUCTION, 中科富海 FULLCRYO, 普达迪泰 PRODETEC, 中铁装备 CREC, 江苏克劳特低温, Western Superconducting Technologies Co.,Ltd., 三井真空, 爱科赛博 ACTIONPOWER, 正帆科技 GENTECH, SEALTECH, SKY, HUALUN, HDKY浩德科仪, RuiYuan, 东方钽业 OTIC, 中国有色集团成员企业, NVT, 冰轮环境 MOON-TECH, JST, 金盘科技, 东方晨景 East Changing, EDWARDS, CBVAC, 黄河勘测规划设计研究院有限公司 Yellow River Engineering Consulting Co., Ltd., 华东勘测设计研究院, 海南展创光电技术有限公司 HZC PHOTONICS, 中国电建 POWERCHINA

Potential international collaborating suppliers and partners worldwide

DANFYSIK, SCANDITRONIX, TOKINARC TOKIN CORPORATION, nichicon, HEINZINGER, DAWONSYS, CAEN Technologies Inc., Kudos Electrical Contracting, PFEIFFER VACUUM, Leybold, VAT, EDWARDS, mks, SUNR Sanei-Kikai Co.,Ltd, VIC INTERNATIONAL, Fujikin, MPC, MIRAPRO, CPI Communications & Power Industries, Canon, THALES Building a future we can all trust, Air Liquide, Linde, Lake Shore CRYOTRONICS, GL research, bergoz, INSTRUMENTATION TECHNOLOGIES, COSYLAB, Osprey Distributed Control Systems, dimtel, Thermo Fisher SCIENTIFIC, ELSE NUCLEAR, HEXAGON

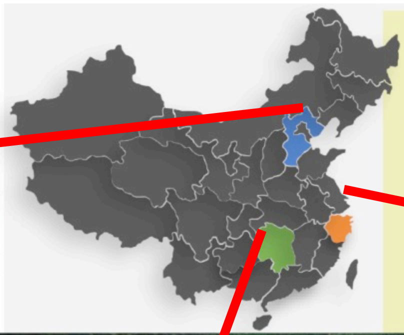
The 8th CEPC IAC Meeting 7

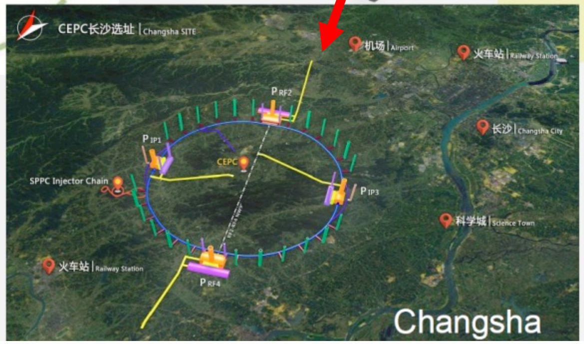
Summary

- CEPC addresses many most pressing and critical science problems in particle physics.
- Accelerator design and technology R&D are reaching maturity, TDR completed, enters EDR phase, ready for construction in 3-5 years.
- Reference detector TDR under preparation, to be completed by the mid-2025 for the proposal of China's 15th 5-year plan.
- CEPC schedule will follow the 15th 5-year plan, call for international experiment collaborations and proposals once CEPC is approved.
- Continue to work with government and funding agencies for support.
- CEPC will offer the worldwide HEP community an early Higgs factory.

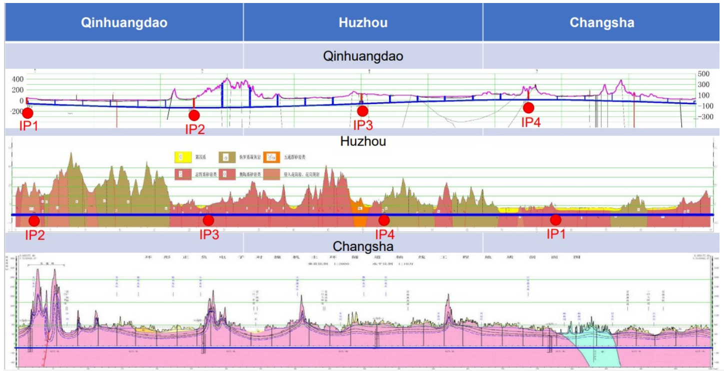
Back up

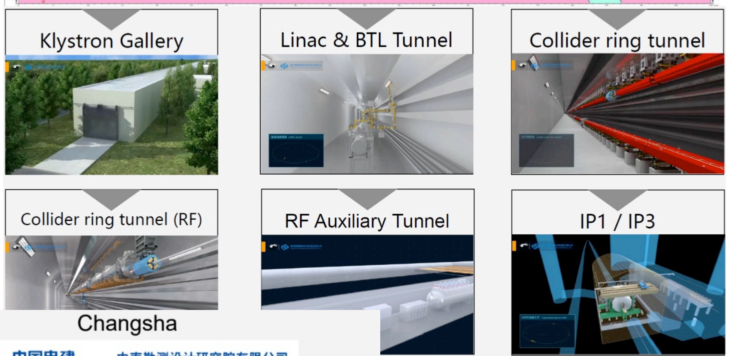
CEPC Site Selection

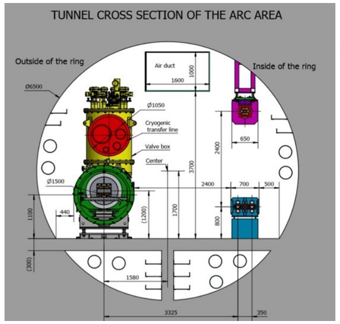




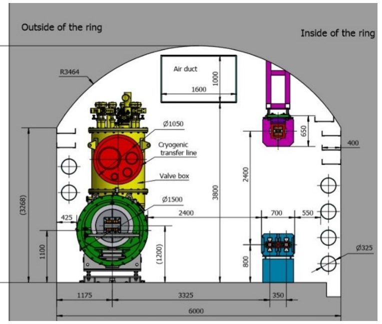
- 3 sites documented in accelerator TDR
- 75-95% of tunnel in granite, low cost



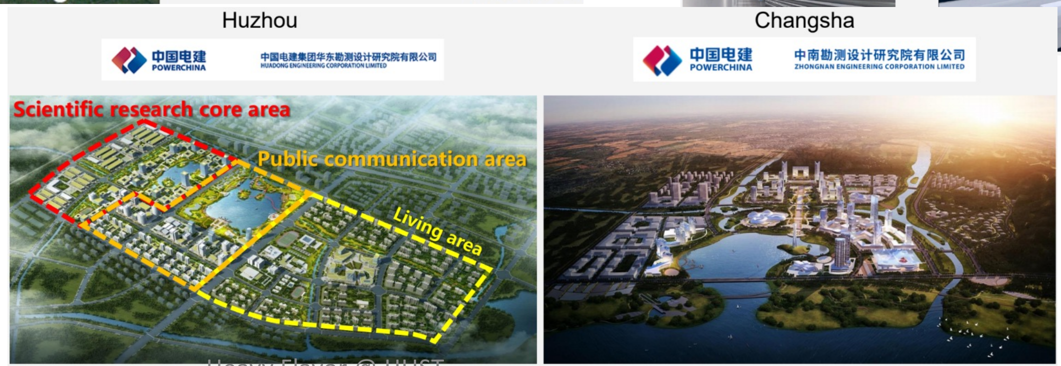




TBM tunnel



Drill-blast tunnel



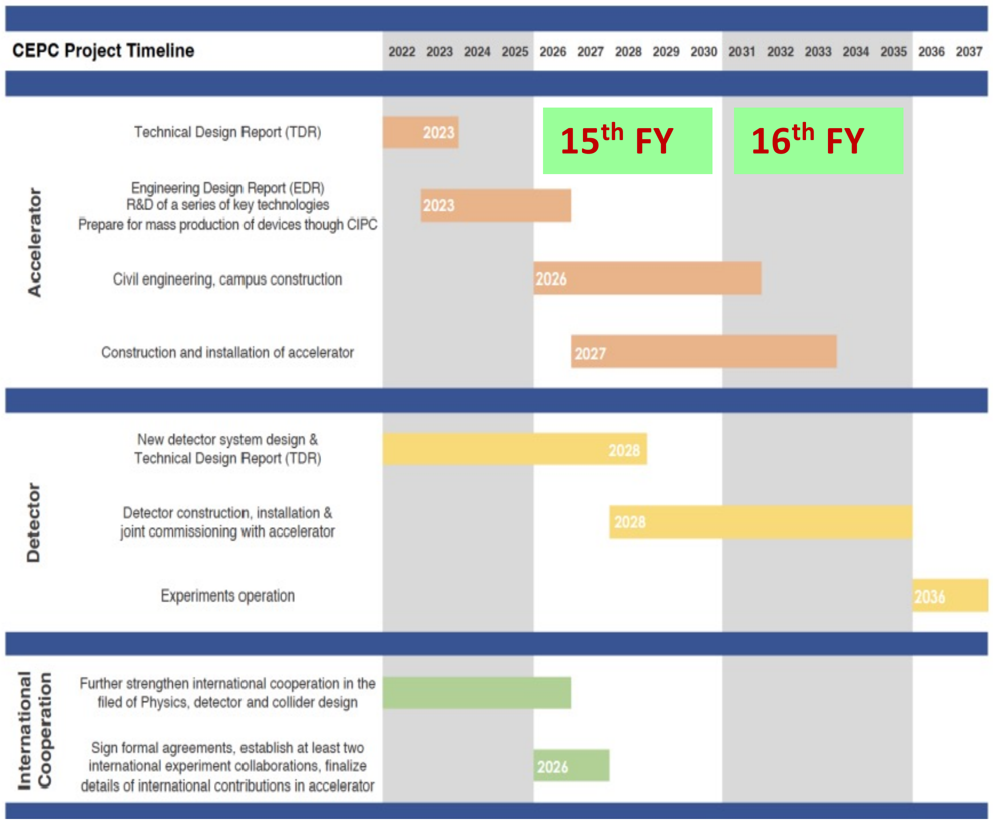
Time for tunnel construction is about 4 – 5 years.

CEPC Planning and Schedule

2012.9	2015.3	2018.11	2023.12	2025.6	2027	15th five year plan (2026-2030)
proposed	Pre-CDR	CDR	Acc. TDR	Det. TDR	EDR	Start of construction

CEPC EDR Phase: 2024-2027

- **CEPC Accelerator EDR** starts with 35 WGs in 2024, to be completed in **2027**
- **CEPC Reference Detector TDR** will be released by June, **2025**
- **CEPC proposal** will be submitted to Chinese government for approval in **2025**
- **Upon approval**, establish at least two international experiment collaborations
- **CEPC construction start** during the 15^{th} five year plan (2026-2030, e.g. **2027**)
- **CEPC construction complete** around **2035**, at the end of the 16^{th} five year plan



Jet origin identification: concept, realization, validation & impact