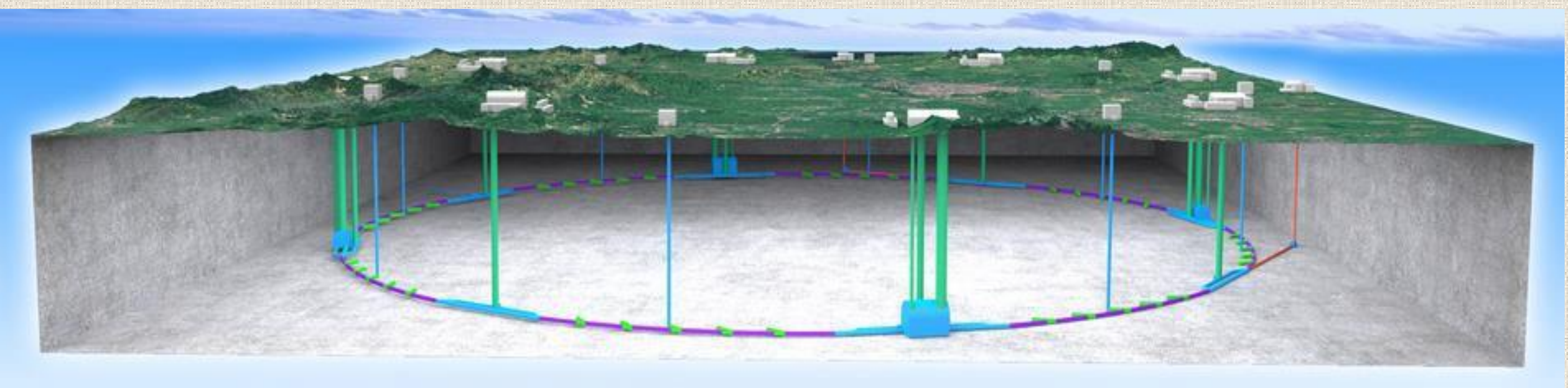
Status and Perspective of The CEPC

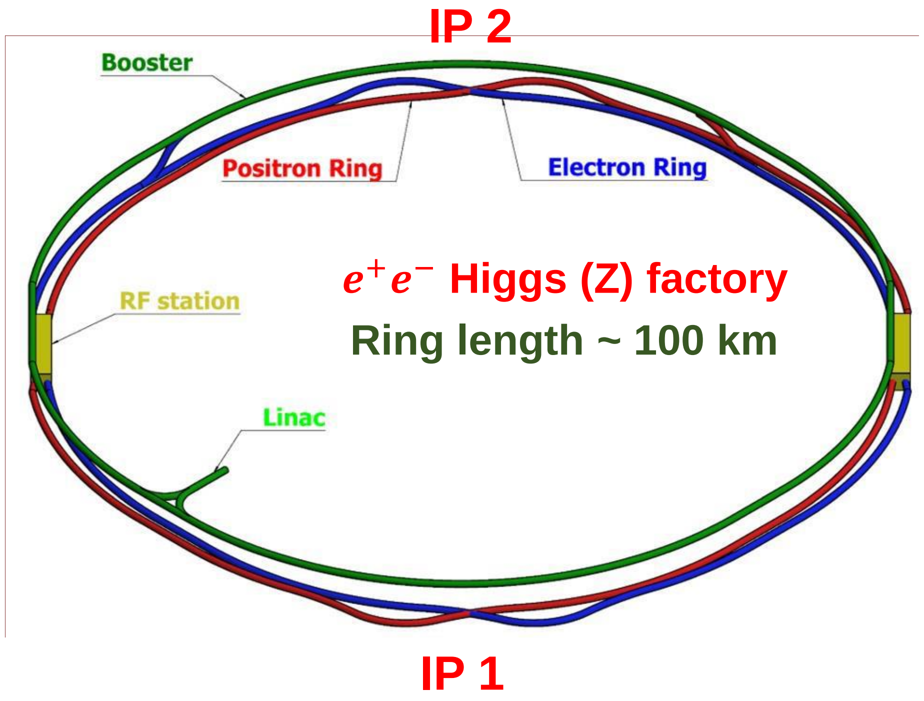
王建春 (IHEP, CAS)
For the CEPC Study Group

海峽兩岸尖端探測器與技術研討會
2024.06.17-19, Taoyuan/Taipei



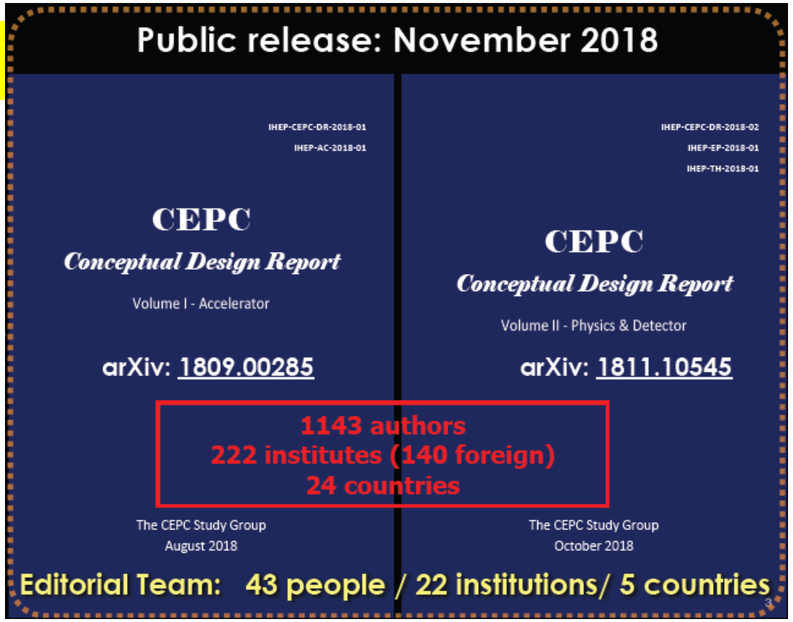
The Circular Electron Positron Collider (CEPC)

- The CEPC was proposed by the Chinese HEP community in 2012 right after the Higgs discovery. It aims to start operation in 2030s, as a Higgs / Z / W factory in China.
- To produce Higgs / W / Z / top for high precision Higgs, EW measurements, studies of flavor physics & QCD, and probes of physics BSM.
- It is possible to upgrade to a *pp* collider (SppC) of $\sqrt{s}$ ~ 100 TeV in the future.



Major Milestones

CEPC CDR Released (2018.11)



Global HEP Consensus on Higgs Factories

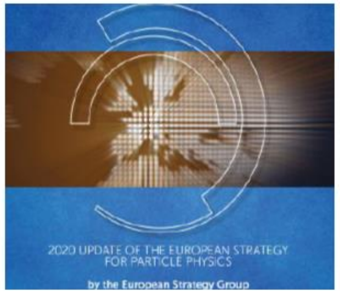
The scientific importance and strategical value of e^+e^- Higgs factories is clearly identified.

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

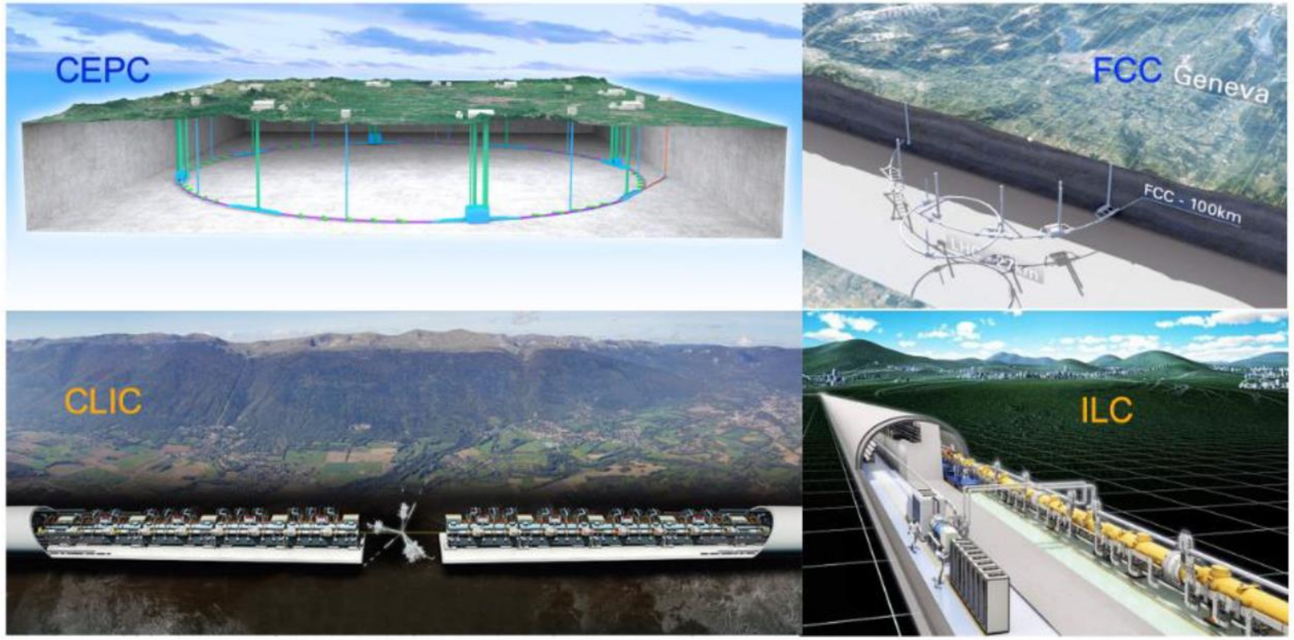
Convene a targeted panel with broad membership across particle physics later this decade that makes decisions on the US accelerator-based program at the time when major decisions concerning an off-shore Higgs factory are expected, and/or significant adjustments within the accelerator-based R&D portfolio 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:

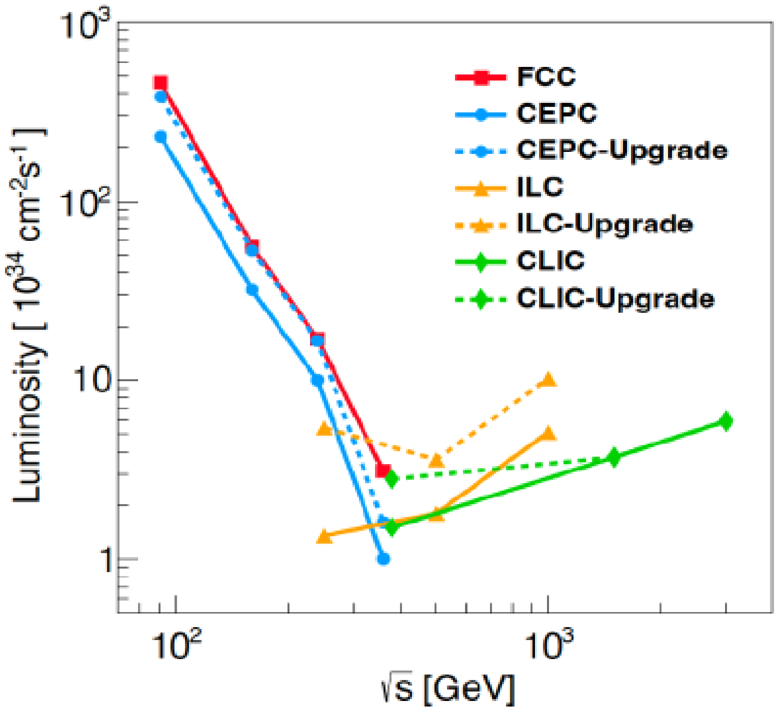
1. The level and nature of US contribution in a specific Higgs factory including an evaluation of the associated schedule, budget, and risks once crucial information becomes available.
2. Mid- and large-scale test and demonstrator facilities in the accelerator and collider R&D portfolios.
3. A plan for 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

Higgs Factory Proposals



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

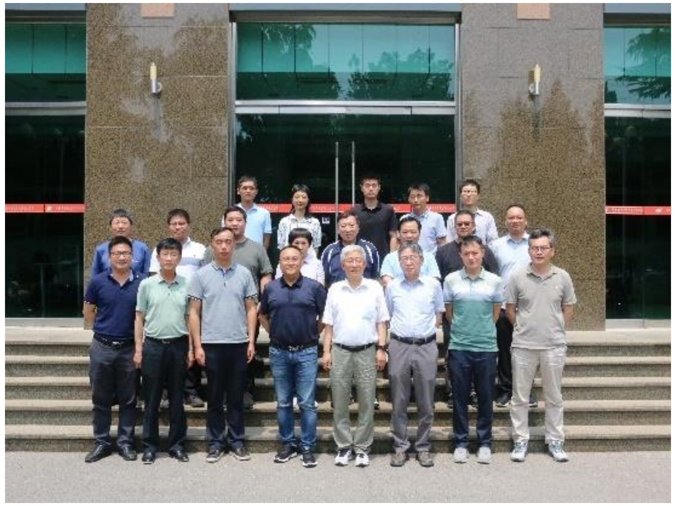
Versus Linear Colliders

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

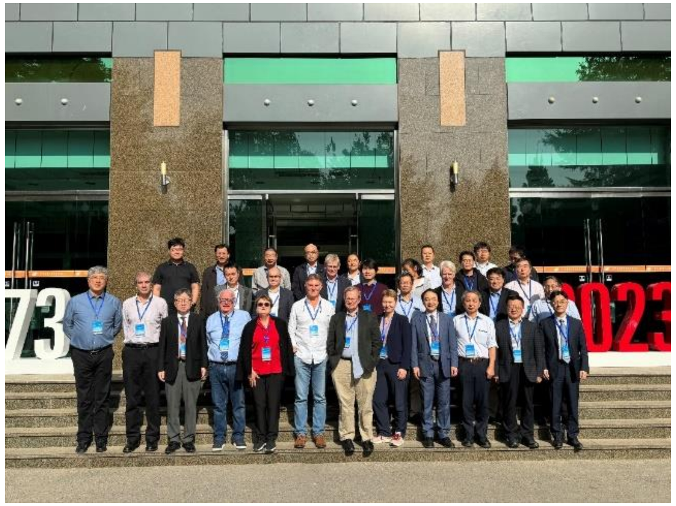
CEPC Accelerator TDR

International Technical Review @ HK, Jun 12-16, 2023

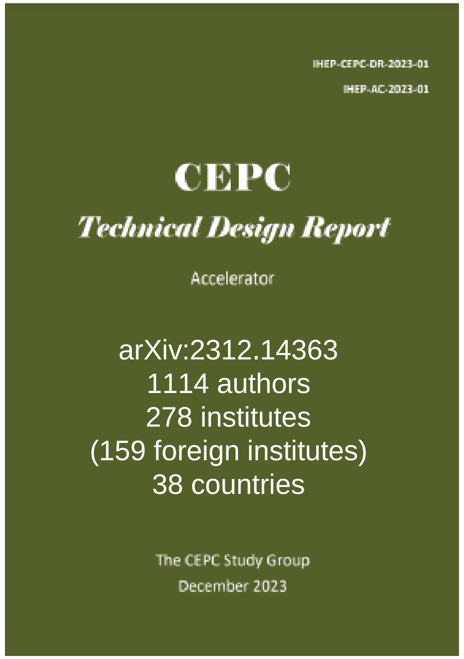
International Cost Review @ HK, Sept 11-15, 2023



Domestic Civil Engineering Cost Review, June 26, 2023



Endorsed by CEPC IAC Oct 29-31, 2023



IHEP-CEPC-DR-2023-01
IHEP-AC-2023-01

CEPC

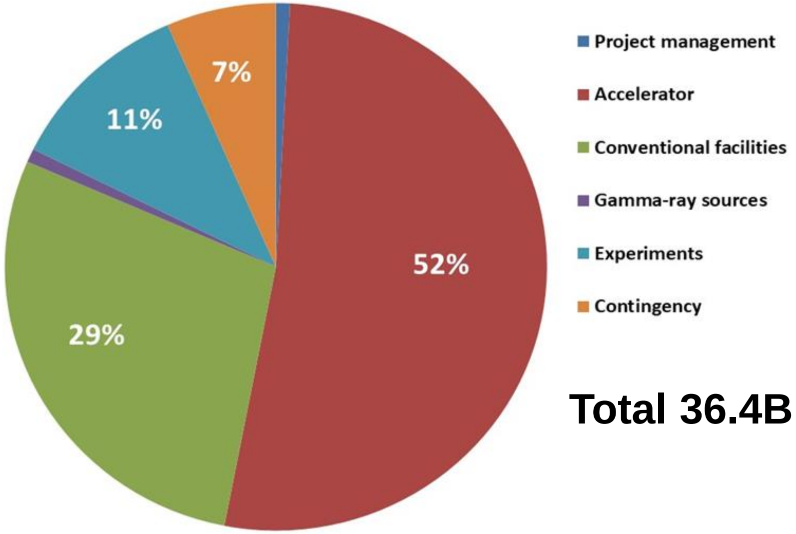
Technical Design Report

Accelerator

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

The CEPC Study Group
December 2023

Accelerator TDR officially released on Dec 25, 2023

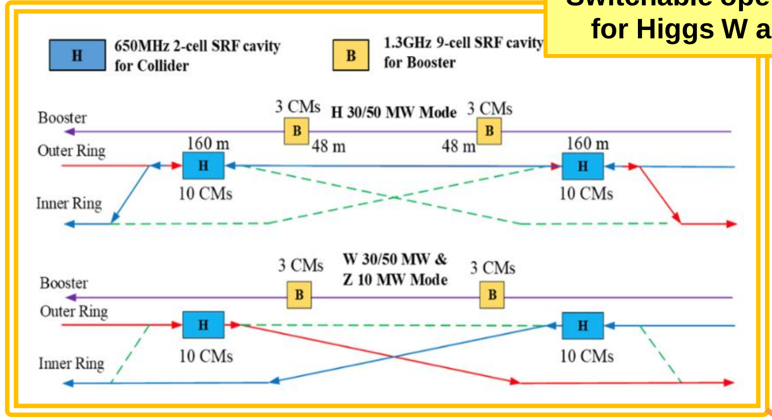


Total 36.4B CNY

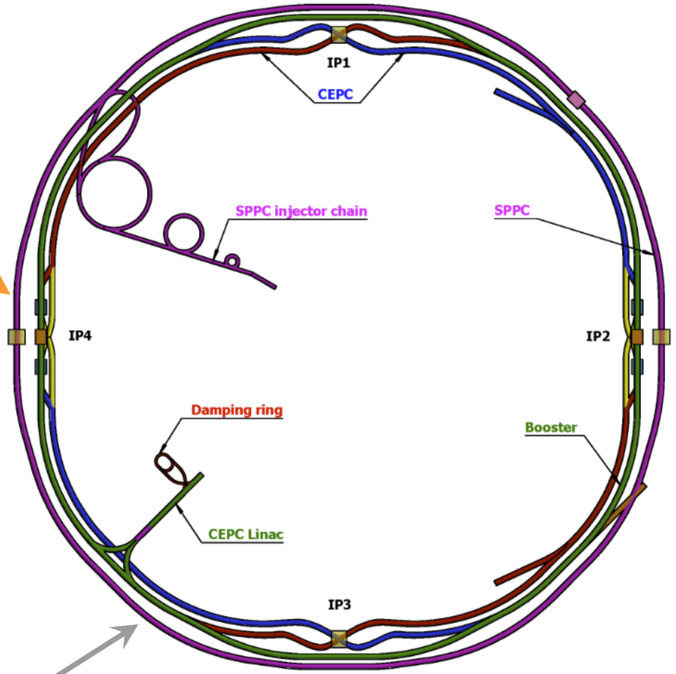
CEPC Layout and Design Essentials

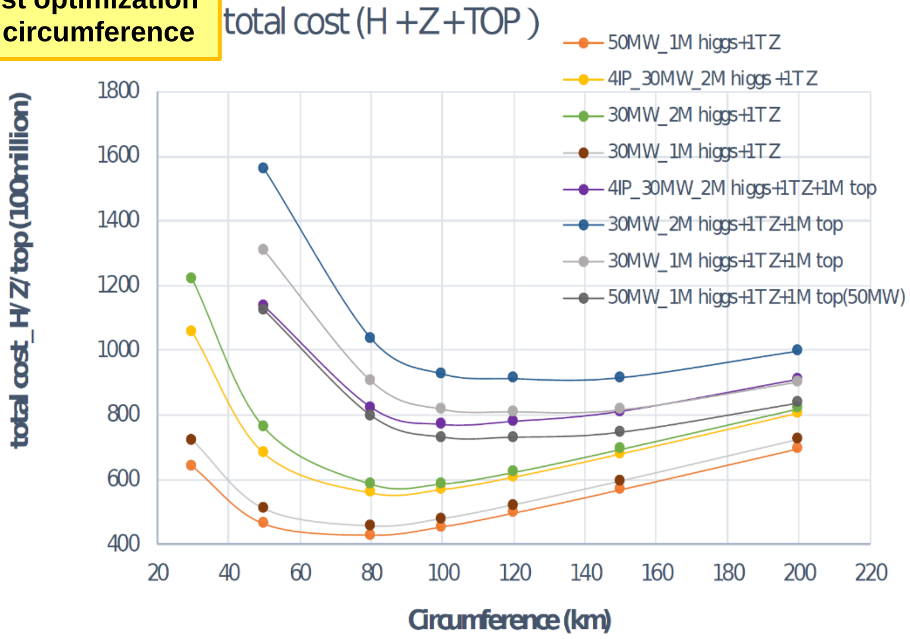
D. Wang *et al* 2022 *JINST* **17** P10018

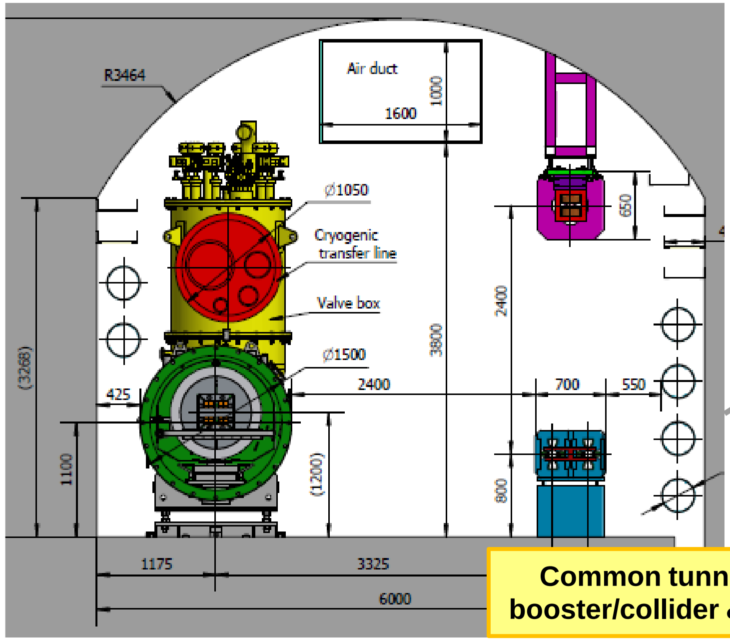
Switchable operation for Higgs W and Z



Cost optimization vs circumference







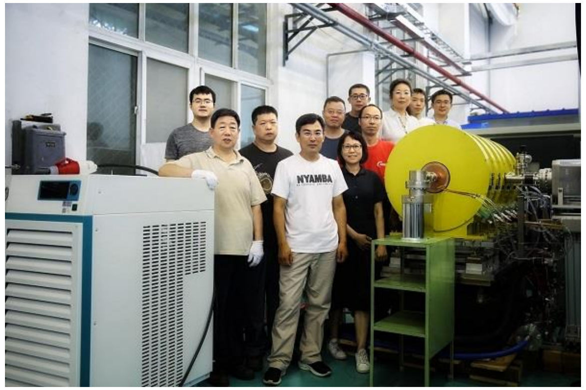
Common tunnel for booster/collider & SppC

- Optimal **100 km circumference**
- **Shared tunnel** for booster, collider and SppC
- Baseline: 30 MW, **upgradable** to 50 MW and $t\bar{t}$
- **Switchable** between Higgs, W/Z, and top modes

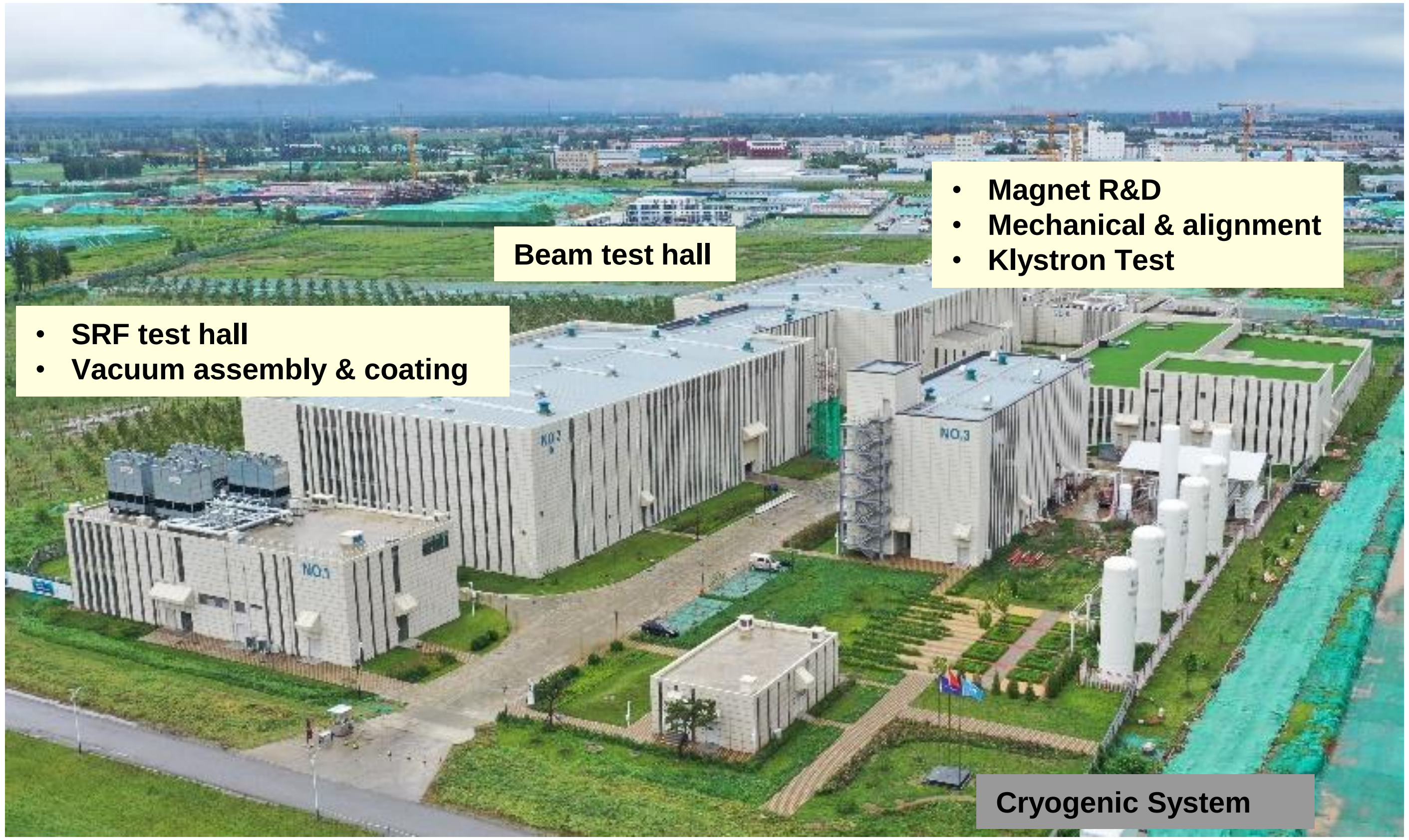
High Energy Photon Source (HEPS)

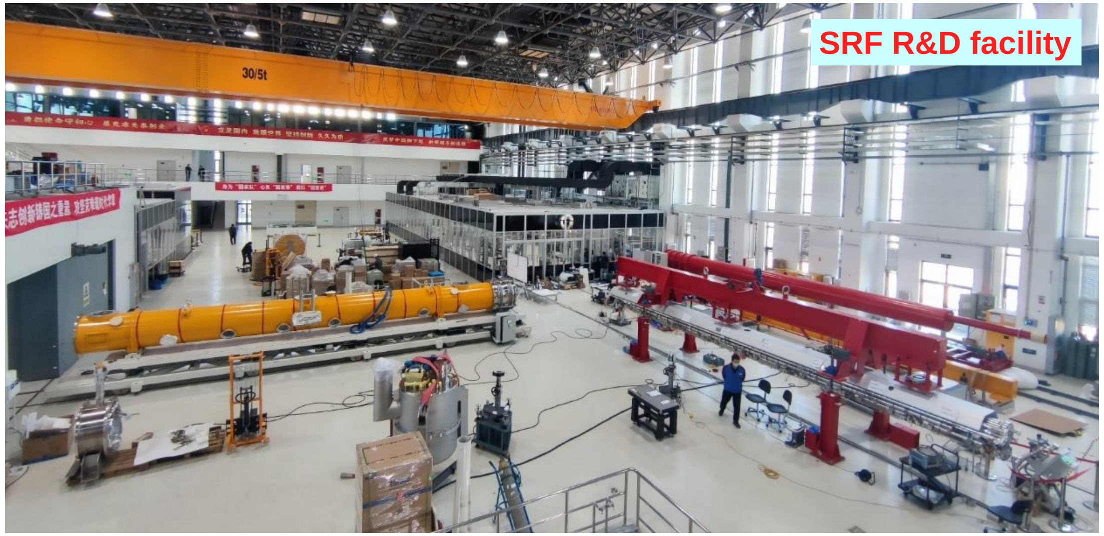
beam energy 6 GeV, 1.36 km
≤ 0.06nm·rad, 14 beam lines

To be completed in 2025, great training and preparation for CEPC



Platform for Key Technology R&D

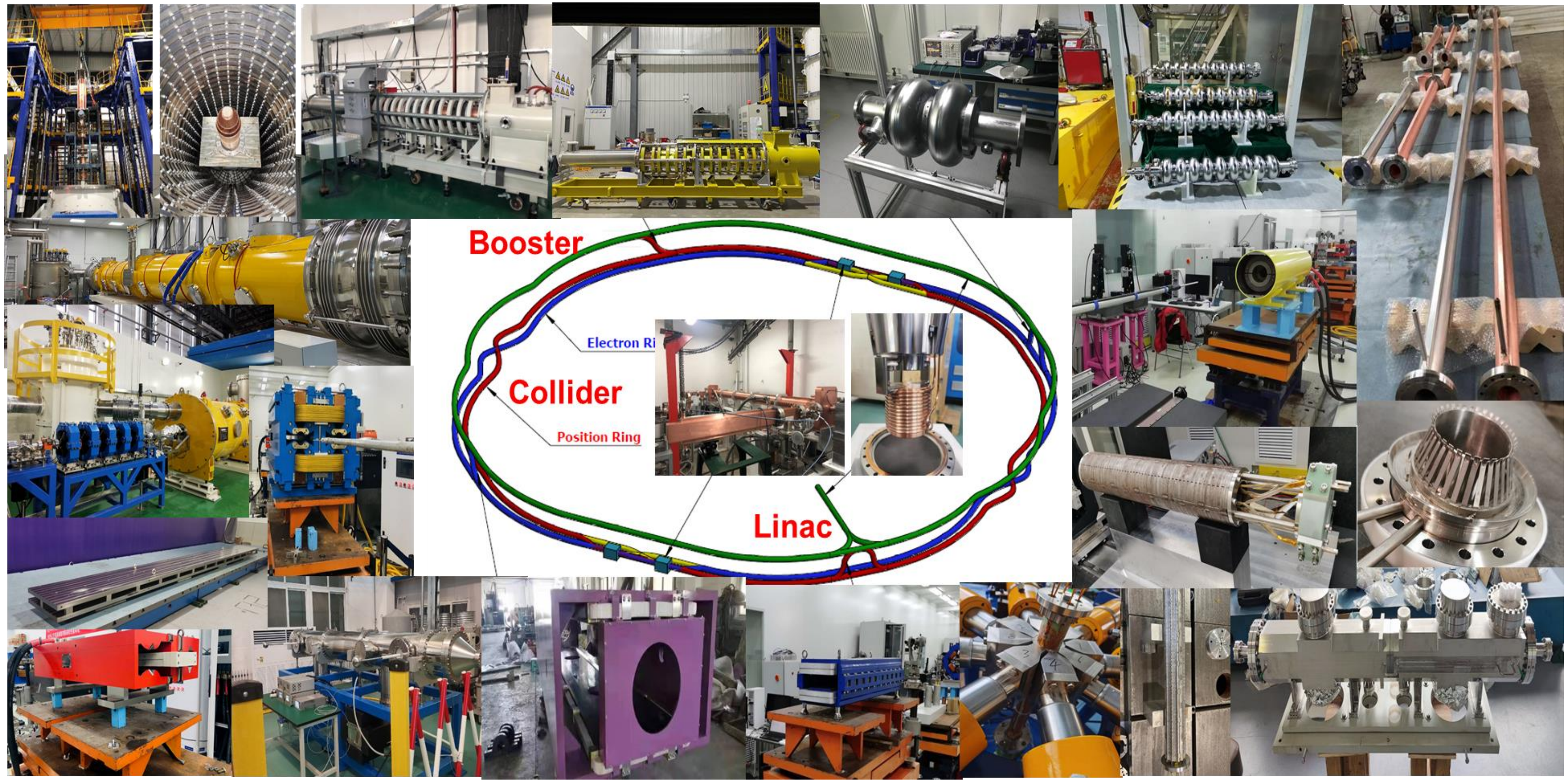




Accelerator key technology R&D platform was established:

- SRF cavity and module
- High precision magnet
- Vacuum assembly & coating
- High efficiency Klystron
- Mechanics and alignment
- Beam test facility

Key Components and Prototype R&D



✔ **Specification Met**

✔ (orange) **Prototype Manufactured**

Accelerator	Fraction
✔ Magnets	27.3%
✔ Vacuum	18.3%
✔ (orange) 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%
✔ (orange) Control	2.4%
✔ (orange) Survey and alignment	2.4%
✔ Radiation protection	1.0%
✔ (orange) SC magnets	0.4%
✔ Damping ring	0.2%

Key technology R&D spans over all components listed in the CEPC CDR

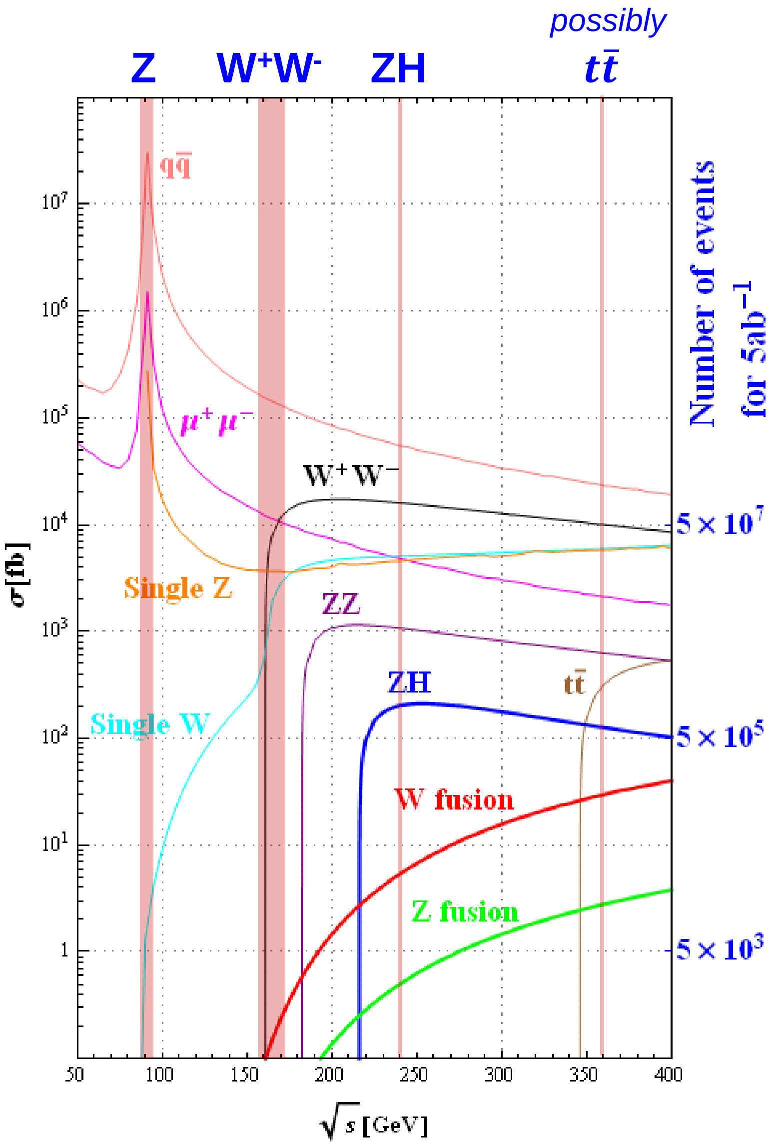
Key Technology Readiness

- CEPC received ~ 260 Million CNY for R&D from MOST, CAS, NSFC, …
- Large amount of key technologies validated in other projects by IHEP: BEPCII, HEPS, …

CEPC R&D ~ 40% cost of acc. components	▪ High efficiency klystron ▪ SRF cavities ▪ Positron source ▪ High performance accelerator	▪ Novel magnets: Weak field dipole, dual aperture magnets ▪ Extremely fast injection/extraction ▪ Electrostatic deflextor ▪ MDI
BEPCII / HEPS ~ 50% cost of acc. components	▪ High precision magnet ▪ Stable magnet power source ▪ Vacuum chamber with NEG coating ▪ Instrumentation, Feedback system	▪ Survey & Alignment ▪ Ultra stable mechanics ▪ Radiation protection ▪ Cryogenic system ▪ MDI

~10% missing items consist of anticipated challenges in the machine integration, commissioning etc to be completed by 2026, and the corresponding international contributions.

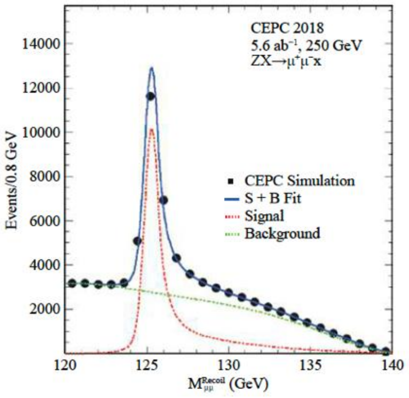
CEPC Operation Plan

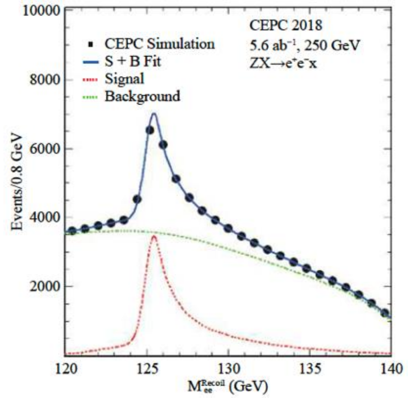


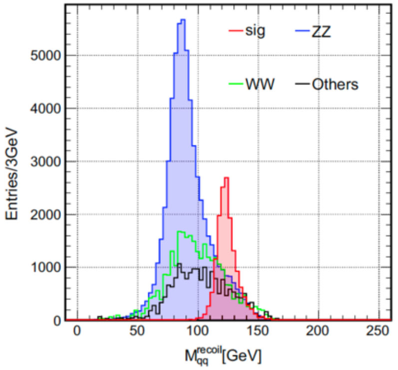
Operation mode		ZH	Z	W⁺W⁻	$t\bar{t}$
$\sqrt{s}$ [GeV]		~240	~91	~160	~360
Run Time [years]		10	2	1	~5
30 MW	L / IP [$\times10^{34}$ cm^{-2}s^{-1}]	**5.0**	**115**	**16**	**0.5**
	$\int L\,dt$ [ab^{-1}, 2 IPs]	13	60	4.2	0.6
	Event yields [2 IPs]	2.6×10^6	2.5×10^{12}	1.3×10^8	4×10^5
50 MW	L / IP [$\times10^{34}$ cm^{-2}s^{-1}]	**8.3**	**192**	**26.7**	**0.8**
	$\int L\,dt$ [ab^{-1}, 2 IPs]	22	100	6.9	1
	Event yields [2 IPs]	4.3×10^6	4.1×10^{12}	2.1×10^8	6×10^5

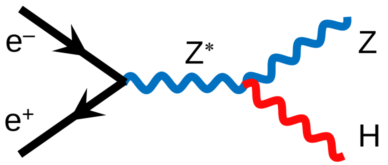
Both 50 MW and $t\bar{t}$ modes are currently considered as upgrades

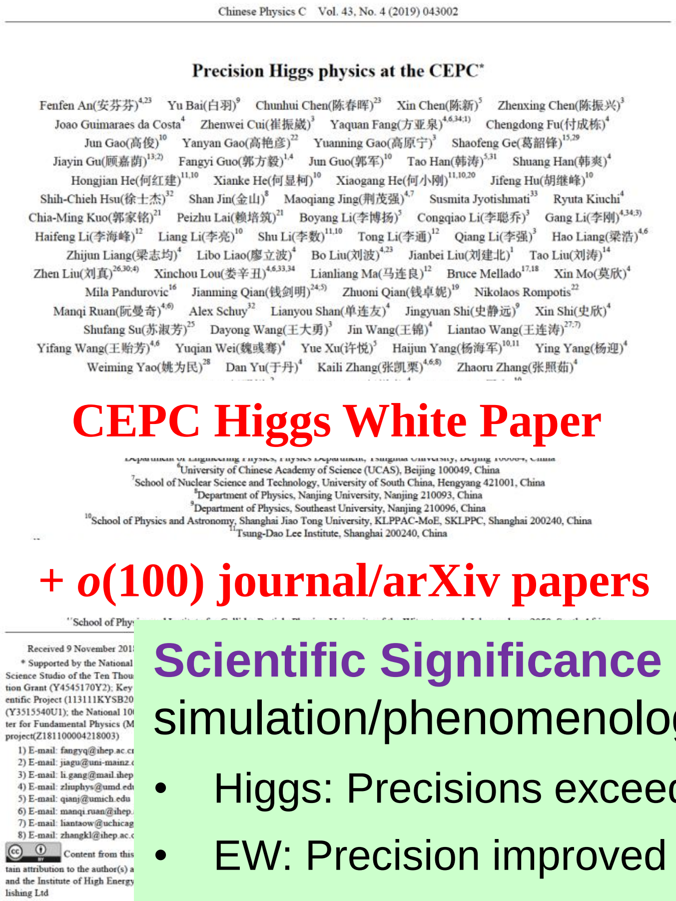
Physics Opportunities @ CEPC











Chinese Physics C Vol. 43, No. 4 (2019) 043002

Precision Higgs physics at the CEPC*

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CEPC Higgs White Paper

+ *o*(100) journal/arXiv papers

Table 2.1: Precision of the main parameters of interests and observables at the CEPC, from Ref. [1] and the references therein, where the results of Higgs are estimated with a data sample of 20 ab^{-1}. The HL-LHC projections of 3000 fb^{-1} data are used for comparison. [2]

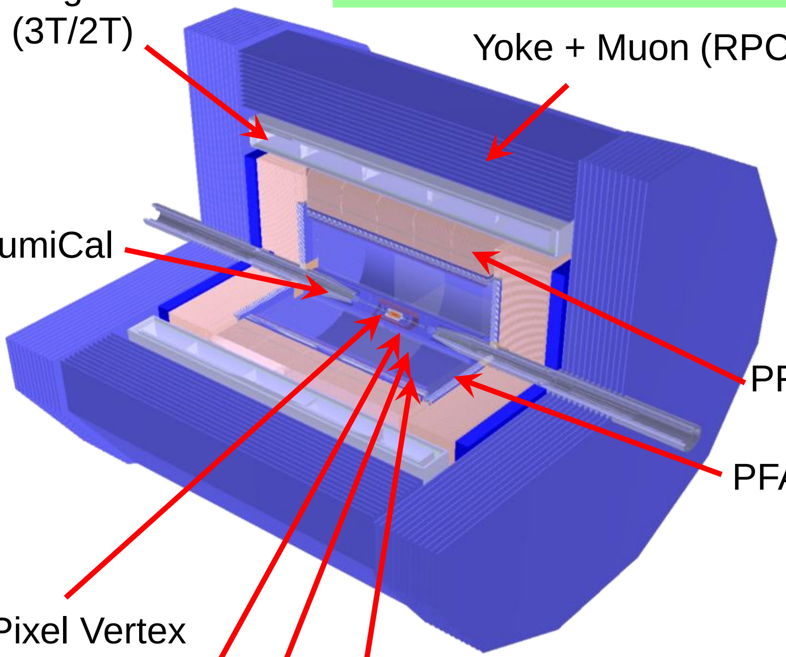
Higgs			W, Z and top		
Observable	HL-LHC projections	CEPC precision	Observable	Current precision	CEPC precision
M_H	20 MeV	3 MeV	M_W	9 MeV	0.5 MeV
Γ_H	20%	1.7%	Γ_W	49 MeV	2 MeV
$\sigma(ZH)$	4.2%	0.26%	M_{top}	760 MeV	$\mathcal{O}(10)$ MeV
$B(H \to bb)$	4.4%	0.14%	M_Z	2.1 MeV	0.1 MeV
$B(H \to cc)$	-	2.0%	Γ_Z	2.3 MeV	0.025 MeV
$B(H \to gg)$	-	0.81%	R_b	3×10^{-3}	2×10^{-4}
$B(H \to WW^*)$	2.8%	0.53%	R_c	1.7×10^{-2}	1×10^{-3}
$B(H \to ZZ^*)$	2.9%	4.2%	R_μ	2×10^{-3}	1×10^{-4}
$B(H \to \tau^+\tau^-)$	2.9%	0.42%	R_τ	1.7×10^{-2}	1×10^{-4}
$B(H \to \gamma\gamma)$	2.6%	3.0%	A_μ	1.5×10^{-2}	3.5×10^{-5}
$B(H \to \mu^+\mu^-)$	8.2%	6.4%	A_τ	4.3×10^{-3}	7×10^{-5}
$B(H \to Z\gamma)$	20%	8.5%	A_b	2×10^{-2}	2×10^{-4}
$Bupper(H \to inv.)$	2.5%	0.07%	N_ν	2.5×10^{-3}	2×10^{-4}

Scientific Significance quantified by **CEPC physics** studies, via full simulation/phenomenology studies:

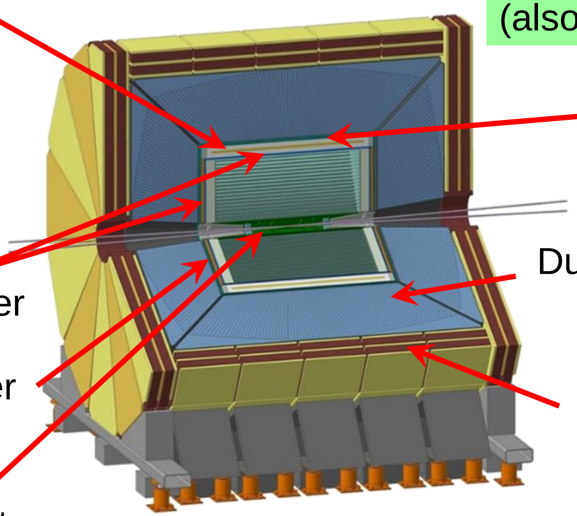
- Higgs: Precisions exceed HL-LHC ~ 1 order of magnitude
- EW: Precision improved from current limit by 1-2 orders
- Flavor Physics, sensitive to NP of 10 TeV or even higher
- Sensitive to varies of NP signal
- ...

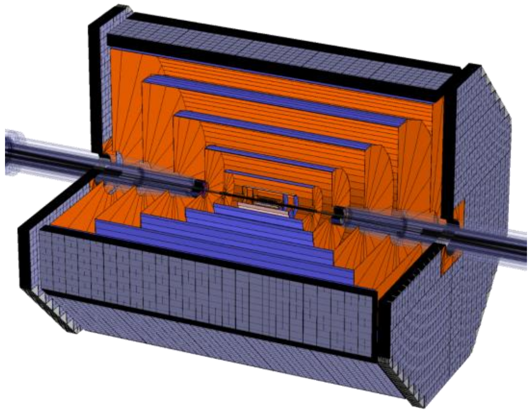
Conceptual Detector Designs

(Baseline Design)
Particle Flow Algorithm



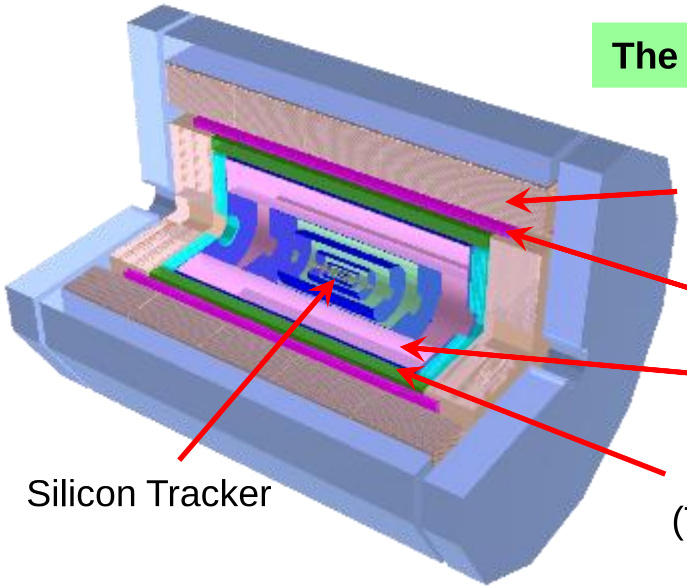
IDEA concept
(also proposed for FCC-ee)





FST concept
(Full Silicon Tracker)

The 4th Concept



Requirements of Detector and Key Technologies

Sub-detector	Key technology	Key Specifications
Silicon vertex detector	Spatial resolution and materials	$\sigma_{r\phi} \sim 3\ \mu m$, $X/X_0 < 0.15\%$ (per layer)
Silicon tracker	Large-area silicon detector	$\sigma(\frac{1}{p_T}) \sim 2 \times 10^{-5} \oplus \frac{1\times10^{-3}}{p\times\sin^{3/2}\theta}(\mathrm{GeV}^{-1})$
TPC/Drift Chamber	Precise dE/dx (dN/dx) measurement	Relative uncertainty 2%
Time of Flight detector	Large-area silicon timing detector	$\sigma(t) \sim 30$ ps
Electromagnetic Calorimeter	High granularity 4D crystal calorimeter	EM energy resolution $\sim 3\%/\sqrt{E(\mathrm{GeV})}$ Granularity $\sim 2 \times 2 \times 2\ \mathrm{cm}^3$
Magnet system	Ultra-thin High temperature Superconducting magnet	Magnet field $2 - 3$ T Material budget $< 1.5 X_0$ Thickness < 150 mm
Hadron calorimeter	Scintillating glass Hadron calorimeter	Support PFA jet reconstruction Single hadron $\sigma_E^{had} \sim 40\%/\sqrt{E(\mathrm{GeV})}$ Jet $\sigma_E^{jet} \sim 30\%/\sqrt{E(\mathrm{GeV})}$

These specifications continue to be optimized

International Efforts on Detector R&D

Det	Technology
Pixel Vertex	JadePix
	TaichuPix
	Arcadia
	CPV(SOI)
	+Stitching
Tracker & PID	CEPCPix / COFFEE
	Si Strip Detector
	TPC
	Drift Chamber
	PID DC
	LGAD ToF
	AC-LGAD
Lumi	SiTrk+Crystal ECAL
	SiTrk+SiW ECAL
	Fast LumMoni

Det	Technology
Calorimeter	4D Crystal ECAL
	Stereo Crystal ECAL
	PS/SiPM+W ECAL
	SiDet+W ECAL
	PS/SiPM+Fe AHCAL
	ScintGlass AHCAL
	RPC SDHCAL
	MPGD SDHCAL
	DR Calorimeter
Muon	Scintillation Bar
	RPC
	μ-Rwell
Misc	HTS / LTS Magnet
	MDI & Integration
	TDAQ scheme

Yiming Li → JadePix, TaichuPix, CEPCPix / COFFEE

Suen Hou → SiTrk+Crystal ECAL

Yong Liu → 4D Crystal ECAL

Huaqiao Zhang → Stereo Crystal ECAL

Haijun Yang → PS/SiPM+W ECAL, PS/SiPM+Fe AHCAL, ScintGlass AHCAL

- International detector R&D efforts for the future Higgs factories
- Some were within the international detector R&D collaborations, e.g. CALICE, LCTPC, & RD*
- Now much broader participation in the ECFA DRD program

Technologies for Ref-TDR

<table>
<tr><th>System</th><th colspan="6">Technologies</th></tr>
<tr><td>Beam pipe</td><td colspan="3">Φ20 mm</td><td colspan="3"></td></tr>
<tr><td>LumiCal</td><td colspan="3">SiTrk+Crystal</td><td colspan="3"></td></tr>
<tr><td>Vertex</td><td colspan="2">CMOS+Stitching</td><td colspan="2">CMOS Pixel</td><td colspan="2">SOI</td></tr>
<tr><td rowspan="4">Tracker</td><td colspan="3">SPD ITrk</td><td colspan="3"></td></tr>
<tr><td colspan="3">Pixelated TPC</td><td colspan="3">PID Drift Chamber</td></tr>
<tr><td colspan="2" rowspan="2">AC-LGAD OTrk</td><td colspan="2">SSD OTrk</td><td colspan="2">SPD OTrk</td></tr>
<tr><td colspan="4">LGAD ToF</td></tr>
<tr><td rowspan="2">ECAL</td><td colspan="3">4D Crystal Bar</td><td colspan="3">Stereo Crystal Bar</td></tr>
<tr><td colspan="2">GS+SiPM</td><td colspan="2">PS+SiPM+W</td><td colspan="2">SiDet+W</td></tr>
<tr><td>HCAL</td><td colspan="2">GS+SiPM+Fe</td><td colspan="2">PS+SiPM+Fe</td><td colspan="2">RPC+Fe</td></tr>
<tr><td>Magnet</td><td colspan="3">LTS</td><td colspan="3">HTS</td></tr>
<tr><td>Muon</td><td colspan="3">PS Bar+SiPM</td><td colspan="3">RPC</td></tr>
<tr><td colspan="7"></td></tr>
<tr><td>TDAQ</td><td colspan="3">Conventional</td><td colspan="3">Software Trigger</td></tr>
<tr><td>BE electr.</td><td colspan="3">Common</td><td colspan="3">Independent</td></tr>
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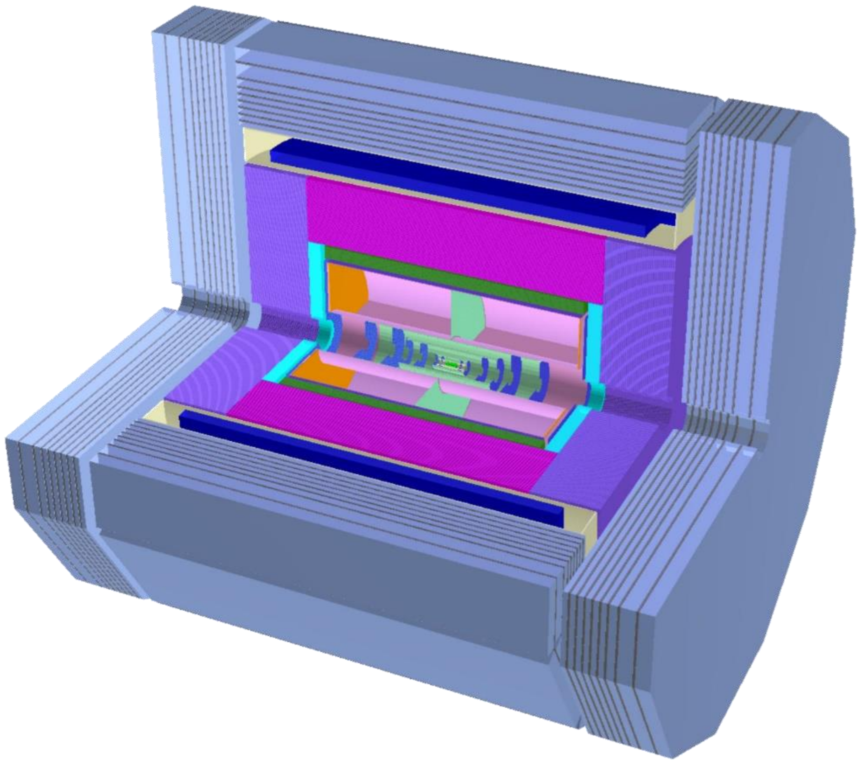
R

Baseline | For Comparison

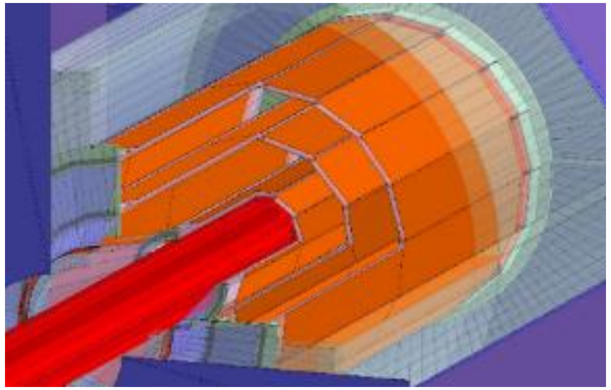


- Prepare TDR of a reference detector, aiming for domestic endorsement, as recommended by the CEPC IAC
- Will continue to seek for better technologies, and decide the final detectors within the CEPC international collaborations

Silicon Pixel Vertex Detector

Looking into stitching technology

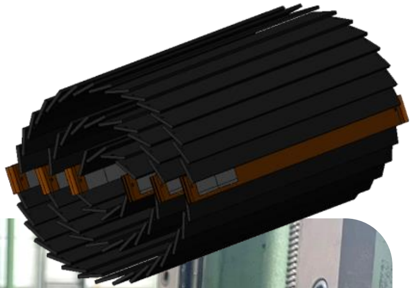
3 × dual-layer design

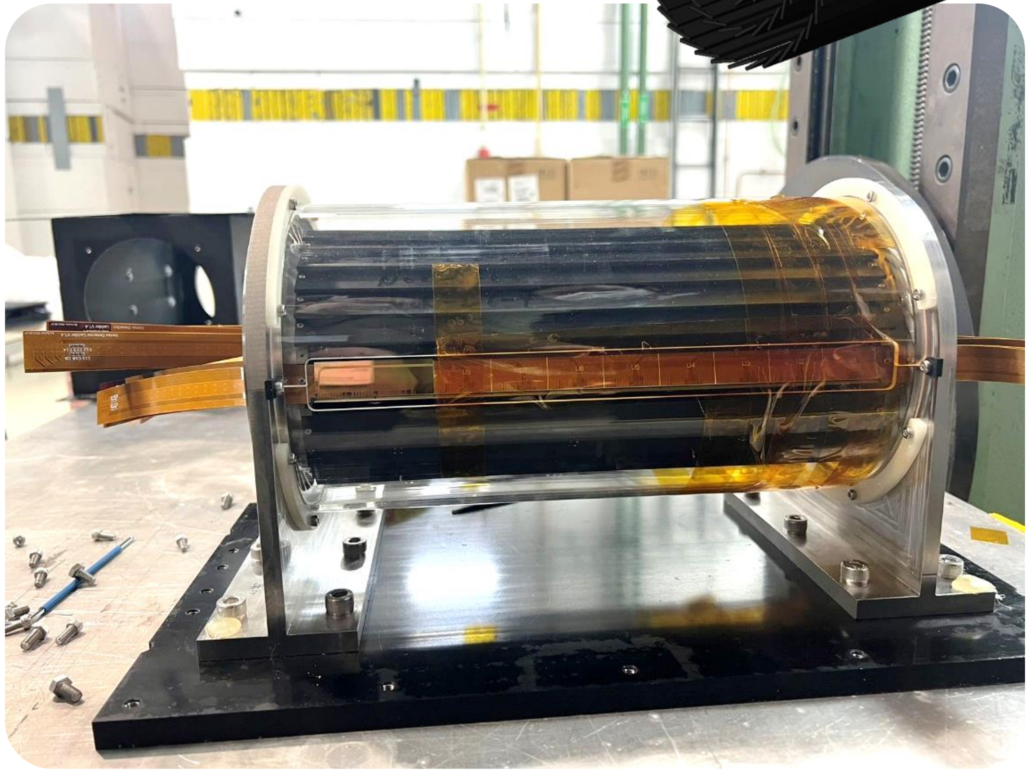


Goal: σ(IP) ~ 5 μm for high P

Key specifications:

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



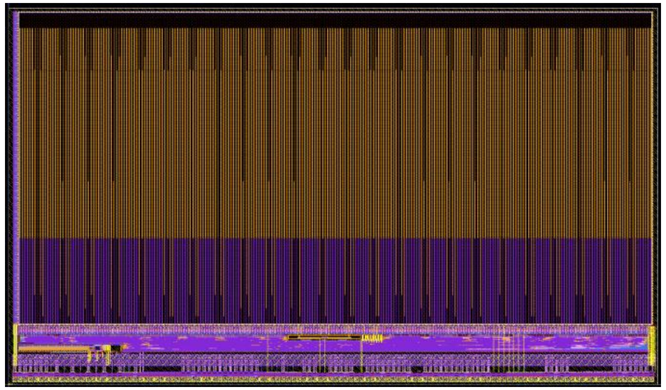


A TaichuPix-based prototype detector was tested at DESY in April 2023

JadePix4

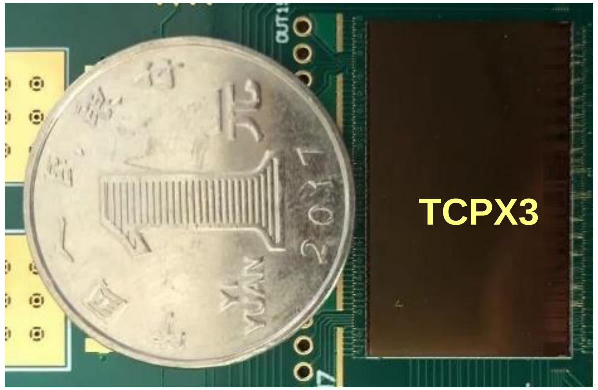
356×498 array of 20×29 μm^2

$\sigma_{x/y}$ ~ 3-4 μm, σ_t ~ 1 μs, ~100 mW/cm^2



TaichuPix3

1024×512 array of 25×25 μm^2

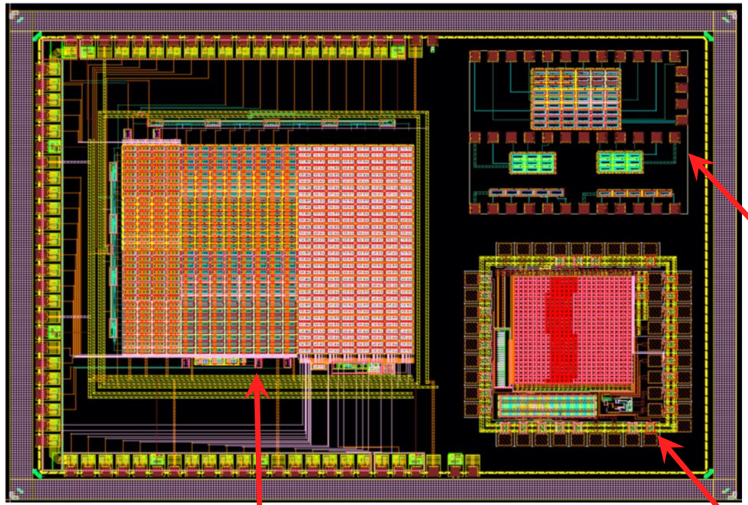


TowerJazz 180nm CIS process

Reference: presentation by Yiming Li

Silicon Pixel Inner Tracker

- Focus on HV-CMOS pixel inner tracker of ~15-20 m^2.
- Ladder design for barrel and disc for endcap
- Given what happened with the TSI 180nm production line, it is better to have backup foundries
- Exploring SMIC 55 nm and TPSCo 65 nm processes



COFFEE2 chip with SMIC 55 nm process

Zone 1

6×9 pixels, 80×40μm^2

Diodes of different charge collection

Zone 2

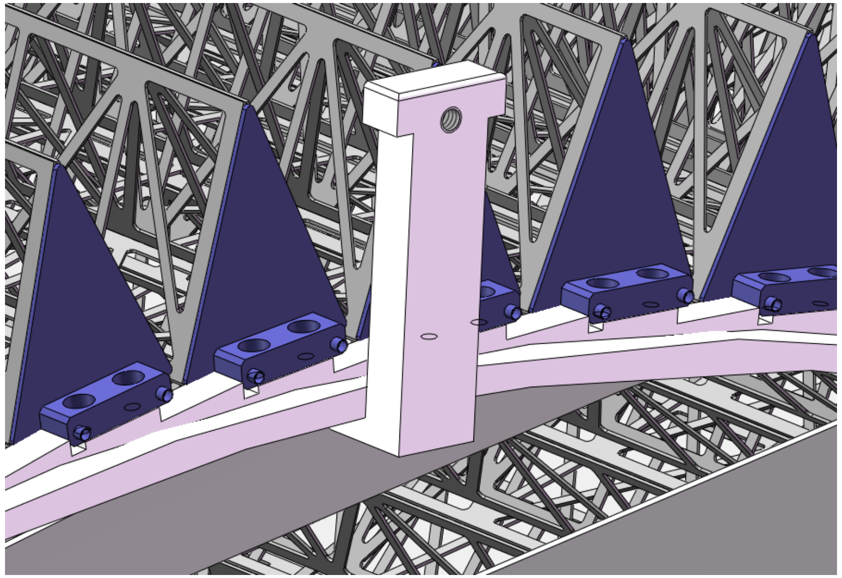
20×32 pixels, 72×36μm^2

Designs of charge collection & cell electronics

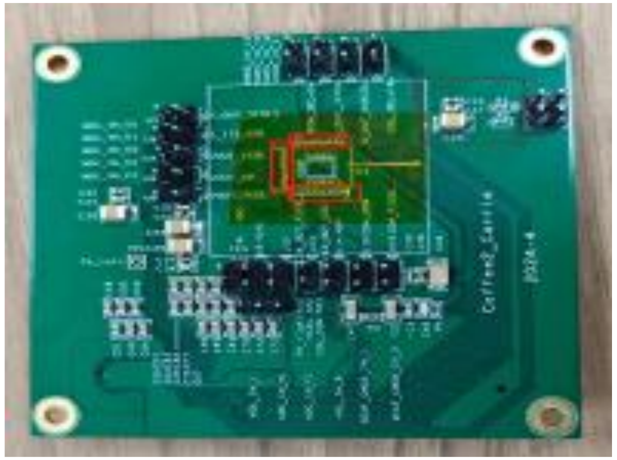
Zone 3

26×26 pixels, 25×25μm^2

Peripheral digital processing and communication



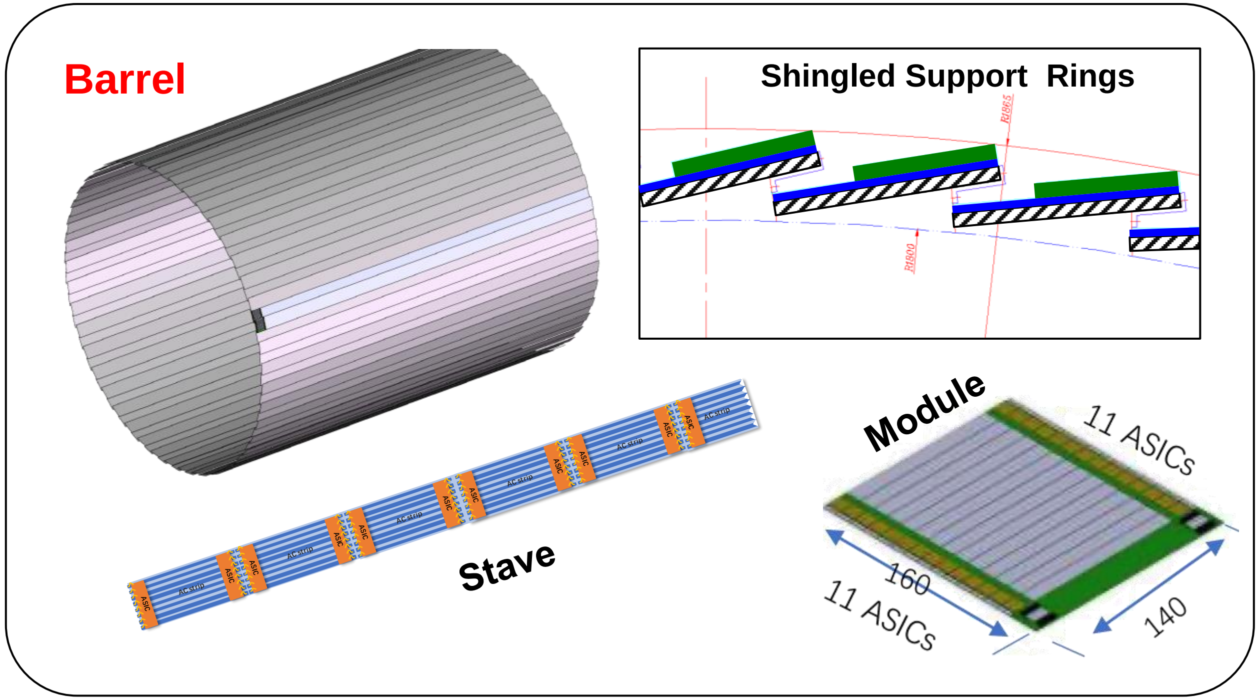
CFRP truss structure: ~0.18% X_0
Outer layer may be attached to TPC



COFFEE2 Test Board

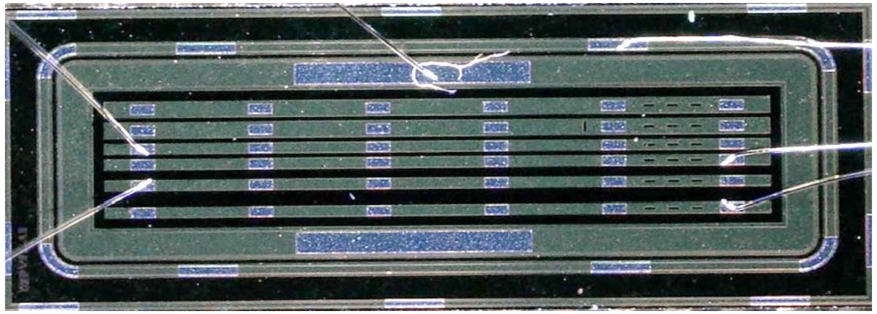
AC-LGAD Outer Tracker (Time Tracker)

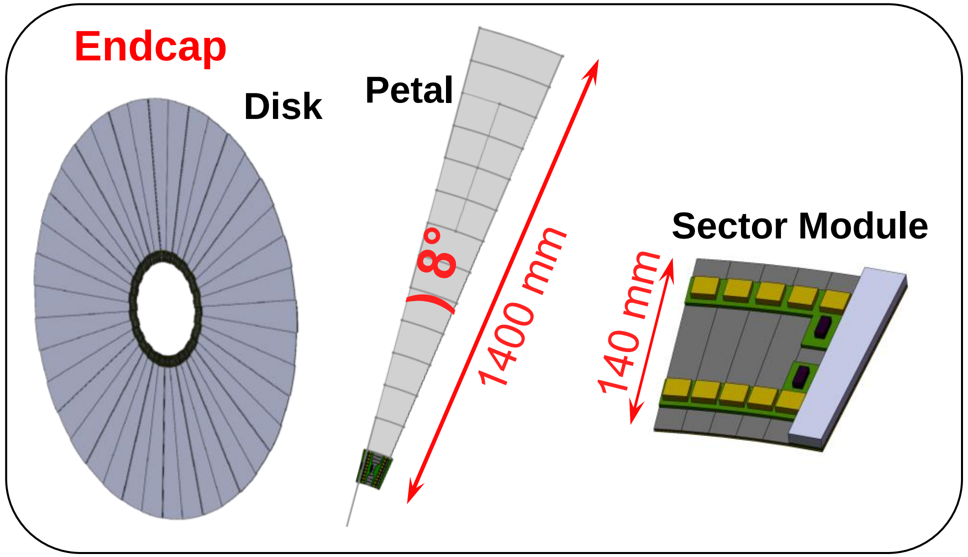
- The outer silicon tracker ~ 85 m^2, the Z precision is not crucial
  $\Rightarrow$ cost-effective Si strip detector
- Need a supplemental PID to TPC at low energy $\Rightarrow$ LGAD ToF
- AC-LGAD Time Tracker combines the two needs in one detector, and expect σ_t ~30 ps, $\sigma_{R\Phi}$ ~10 μm



Strip AC-LGAD by IHEP / IME

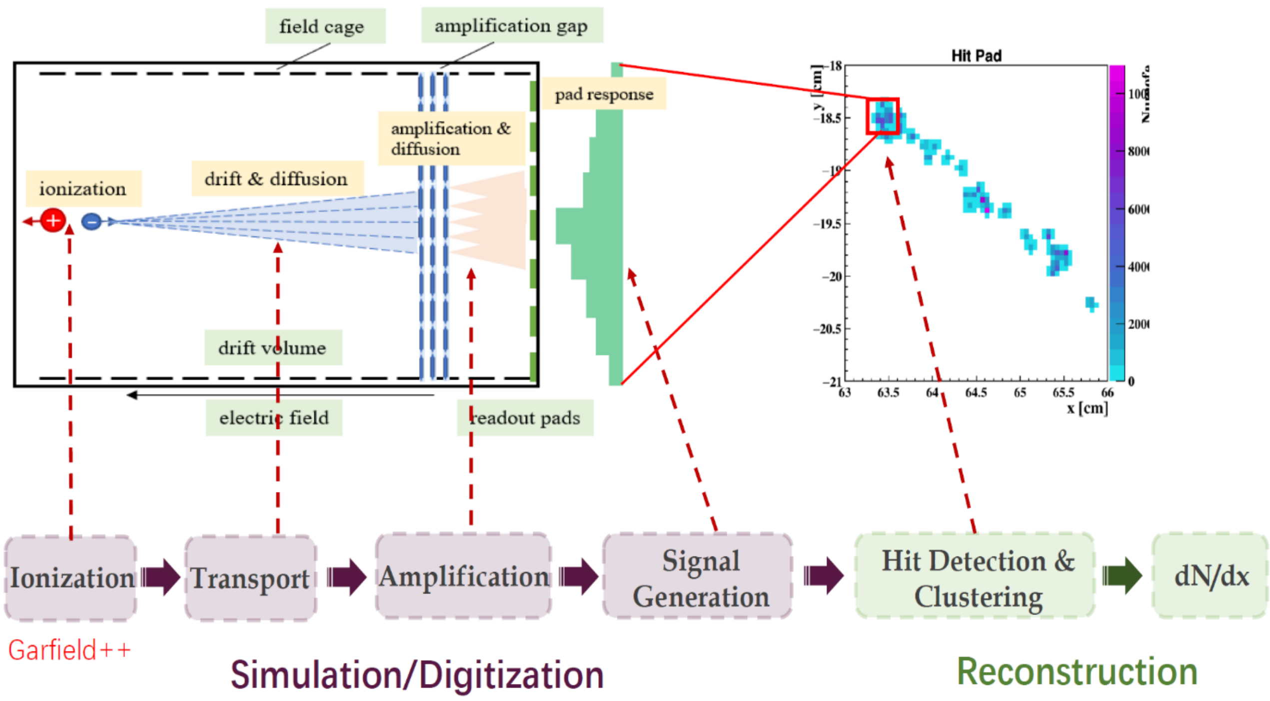
Strip size 5.6 mm × 100 μm
Pitch: 150, 200, 250 μm

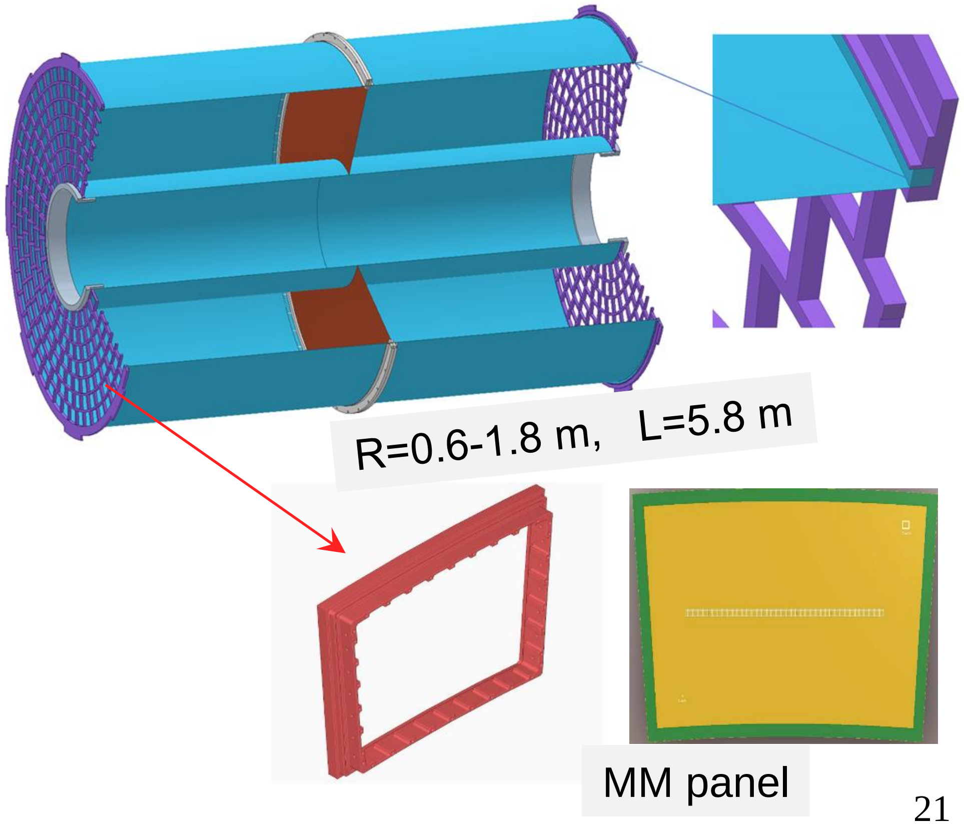




Pixelated TPC

- Initial TPC design has difficulty at high luminosity Z pole due to IBF
- A pixelated TPC achieves σ(r-Φ) ~100 μm, with $(500\ \mu m)^2$ readout pads, IBF×Gain ~1 at G=2000
- Full simulation study also shows 3σ K/π separation at 20GeV
- Preliminary mechanical design ⇒ RL = 15% X_0 for endcap and 0.55% X_0 for barrel part
- Plan to have a test beam this fall to characterize the performance and validate the design

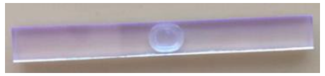


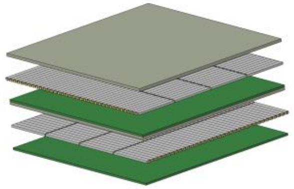


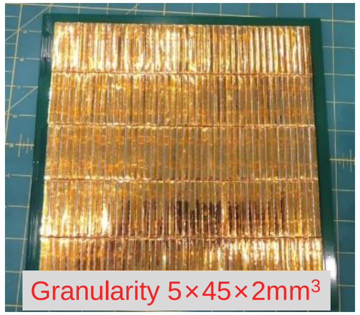
Prototype PFA Calorimeters

- ScW-ECAL: transverse 20×20 cm, 32 sampling layers
  - ~6,700 channels, SPIROC2E (192 chips)
- AHCAL: transverse 72×72 cm, 40 sampling layers
  - ~13k channels, SPIROC2E (360 chips)

ECAL: scintillator(strip)+SiPM, CuW

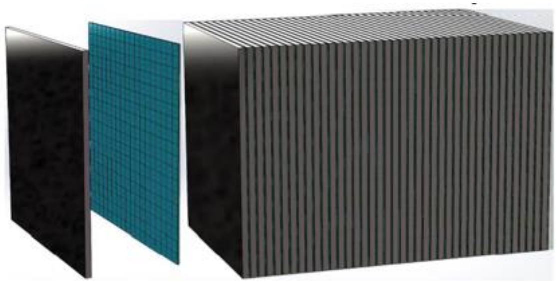


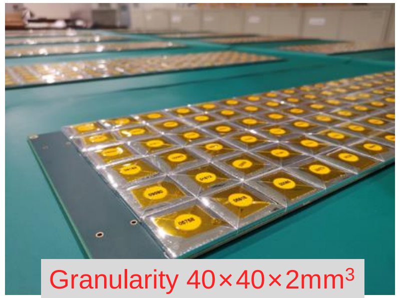




Granularity 5×45×2mm^3

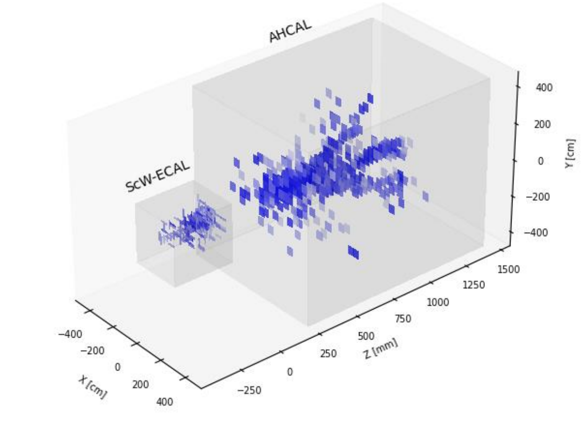
HCAL: scintillator (tile)+SiPM, steel

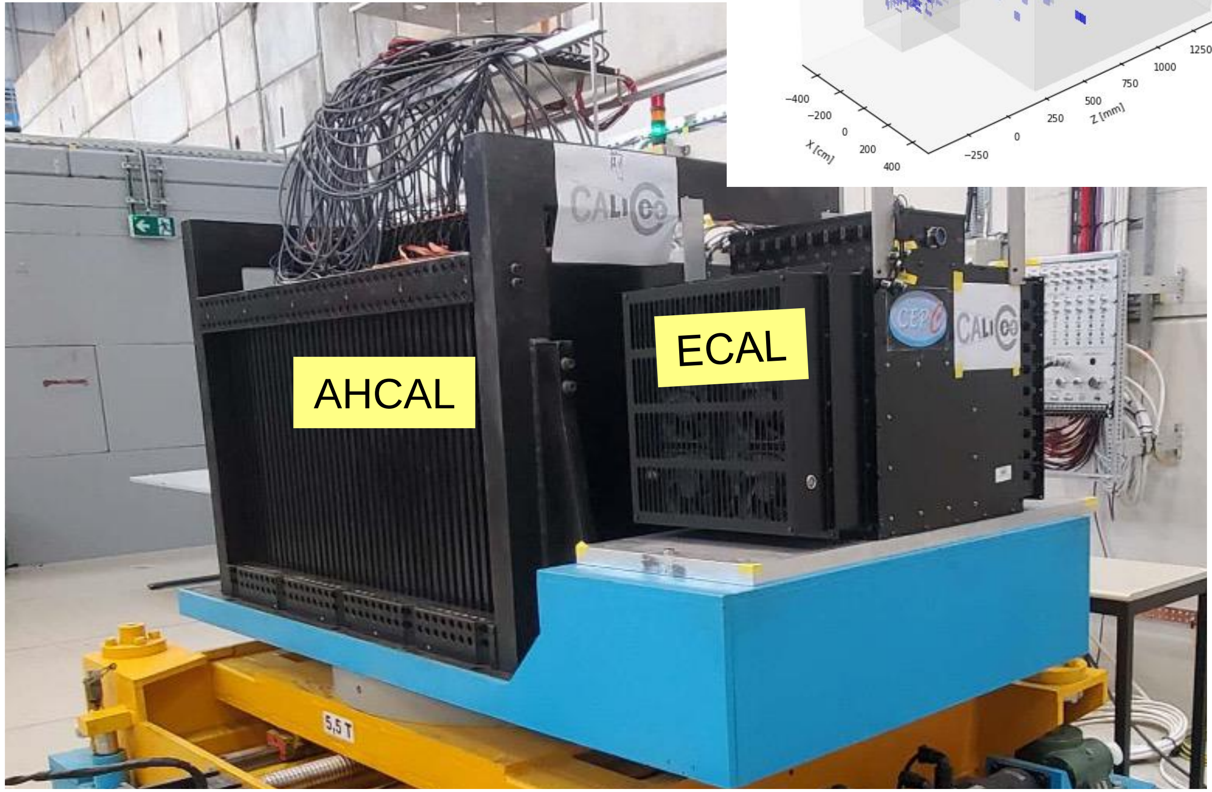




Granularity 40×40×2mm^3

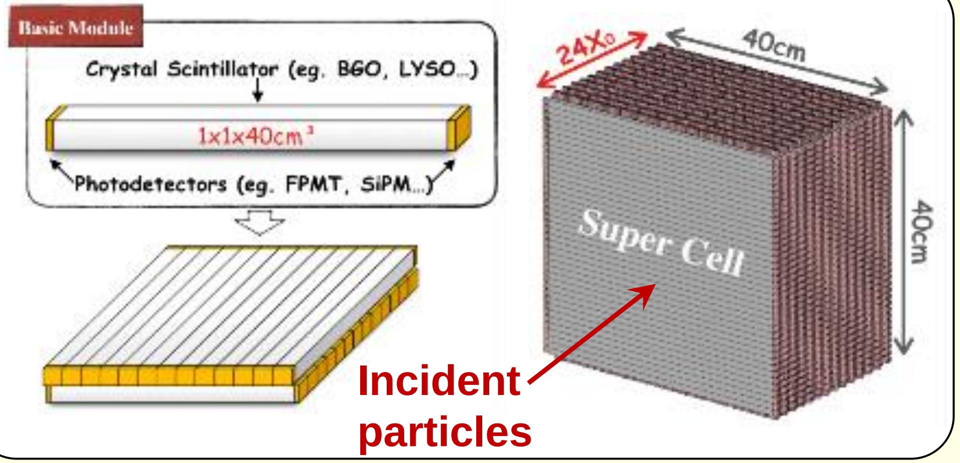
Several successful testbeams @ CERN

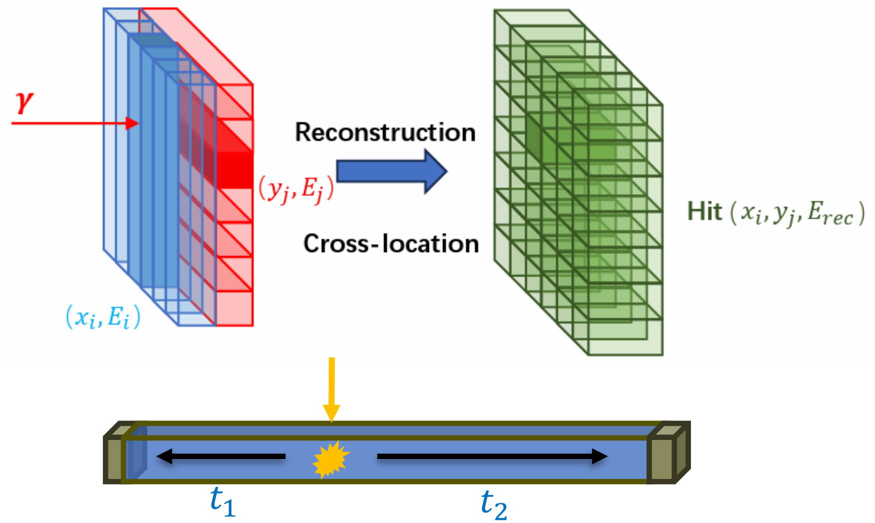




Reference: presentation by Haijun Yang

Crystal Bar Calorimeter

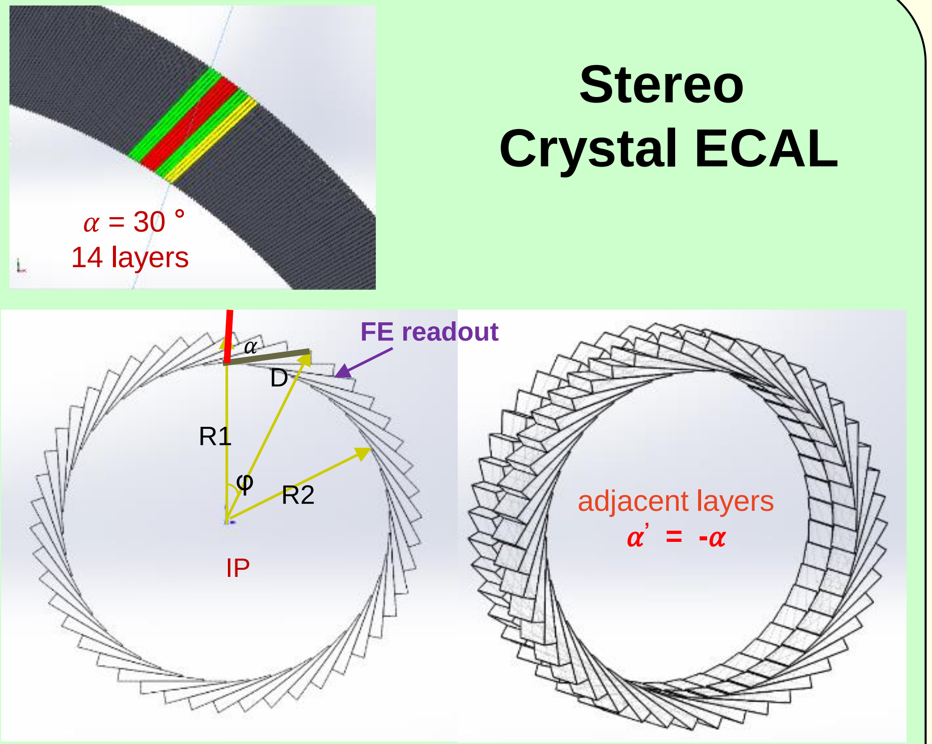




Achieve high granularity with adjacent layers

- Double-end readout, potentially positioning with timing
- Save readout channels, minimize dead area and material
- Challenging in pattern recognitions with multiple particles

Stereo Crystal ECAL



Single-end readout, achieve PFA with adjacent rings at stereo angles

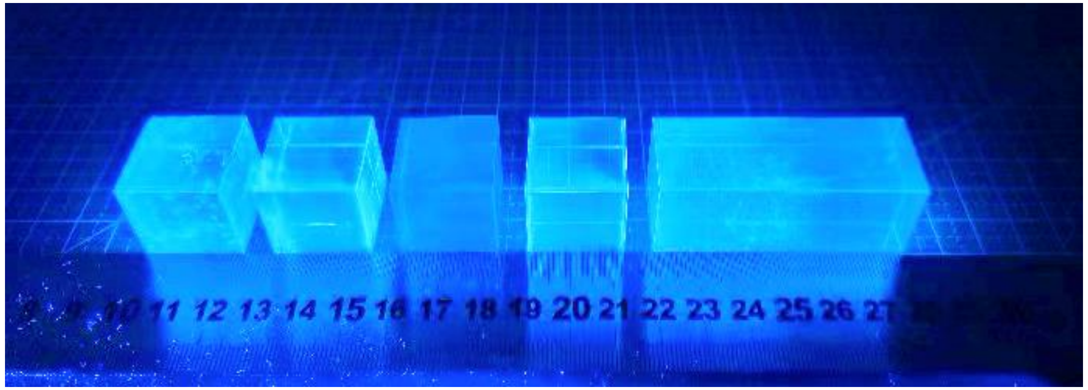
Reference: presentation by Yong liu

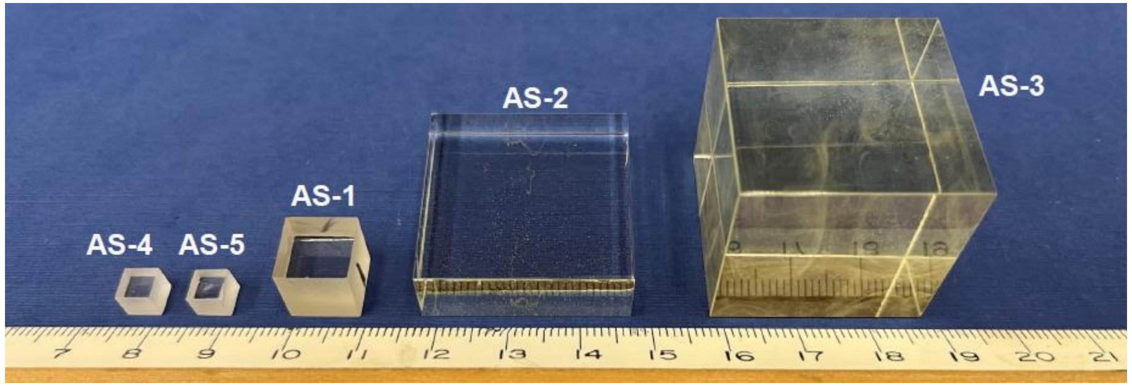
Reference: presentation by Huaqiao Zhang

Glass Scintillator HCAL

- To replace plastic scintillator with high density, low cost glass scintillator, for better hadronic energy resolution and BMR
- Key specifications:
  - Light yield: 1000~2000 ph / MeV
  - Density: 5~7 g/cm^3
  - Scintillation time: ~100 ns
- The Scintillation Glass collaboration continues to progress on the quest for better GS
- The GS1 / GS5 measurements are from (5mm)^3 small size samples. Tiles of 40×40×10 mm^3 are needed for GS-HCAL

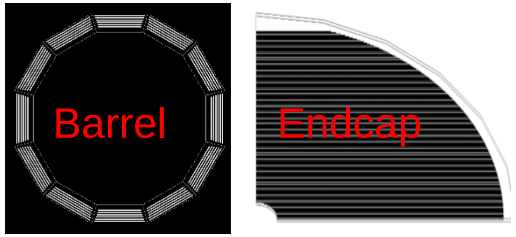
Parameters	Unit	BGO	LYSO	GAGG	GS1	GS5
Density	g/cm^3	7.13	7.5	6.6	6.0	5.9
Hygroscopicity	--	No	No	No	No	No
Rad. Length, X_0	cm	1.12	1.14	1.63	1.59	1.61
Transmittance	%	82	83	80	80	80
Refractive Index	--	2.1	1.82	1.91	1.74	1.75
Emission peak	nm	480	420	520	390	390
Light yield, LY	ph/MeV	8000	3000	54000	1347	1154
Energy resol., ER	%	9.5	7.5	5.0	25.3	25.4
Decay time	ns	60, 300	40	100	80,600	90,300





Muon Detector

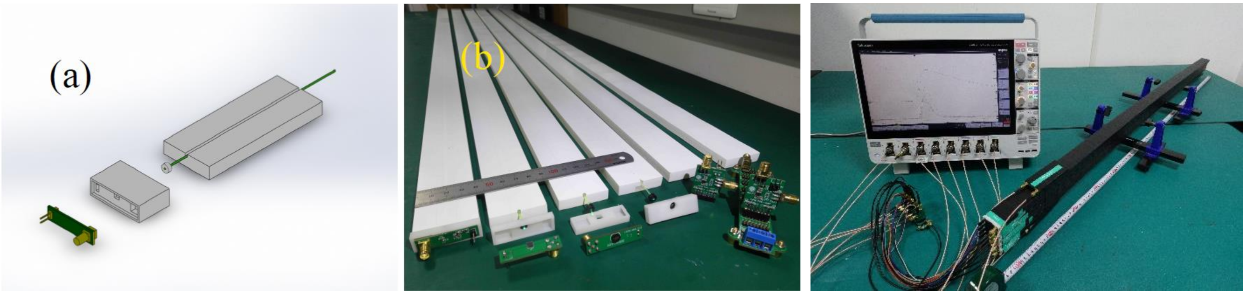
- Muon ID, combining with magnet return
- Requirement: $\epsilon > 95\%$, σ_T ~1-2 ns
- Total area ~ 4500 m^2, ~40k channels
- Top options: plastic scintillator and RPC

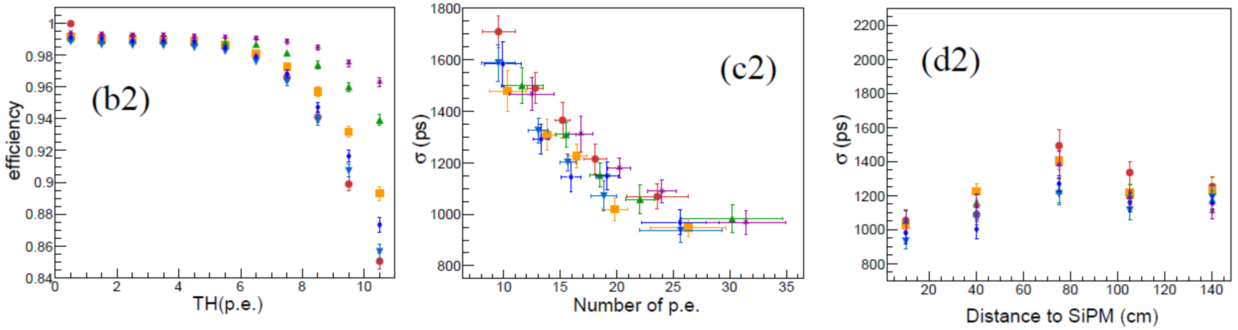


PS muon detector

Extruded plastic scintillator, WLS fibre, and SiPM

Preliminary results: $\epsilon > 95\%$ and $\sigma_T < 1.5\ ns$

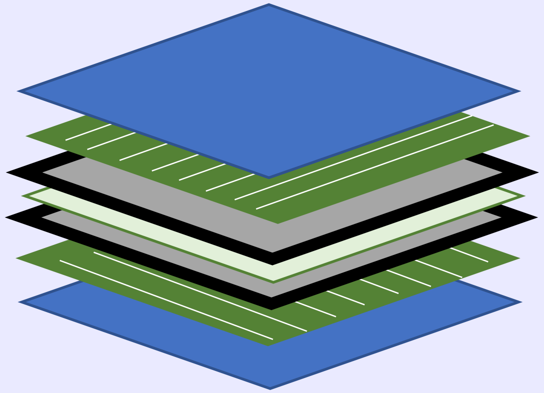


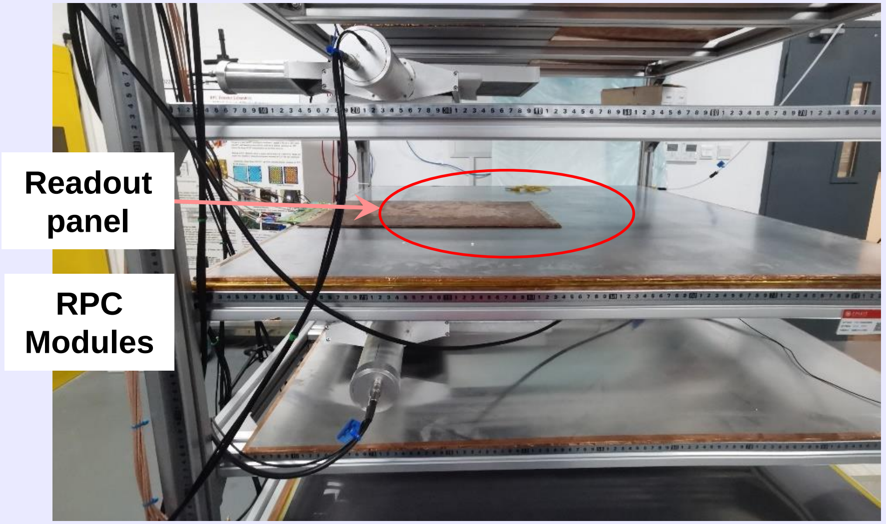


RPC muon detector

Experience from BES, DYB experiments

Insulation layer
X readout
RPC_up
Grounding
RPC_down
Y readout
Insulation layer

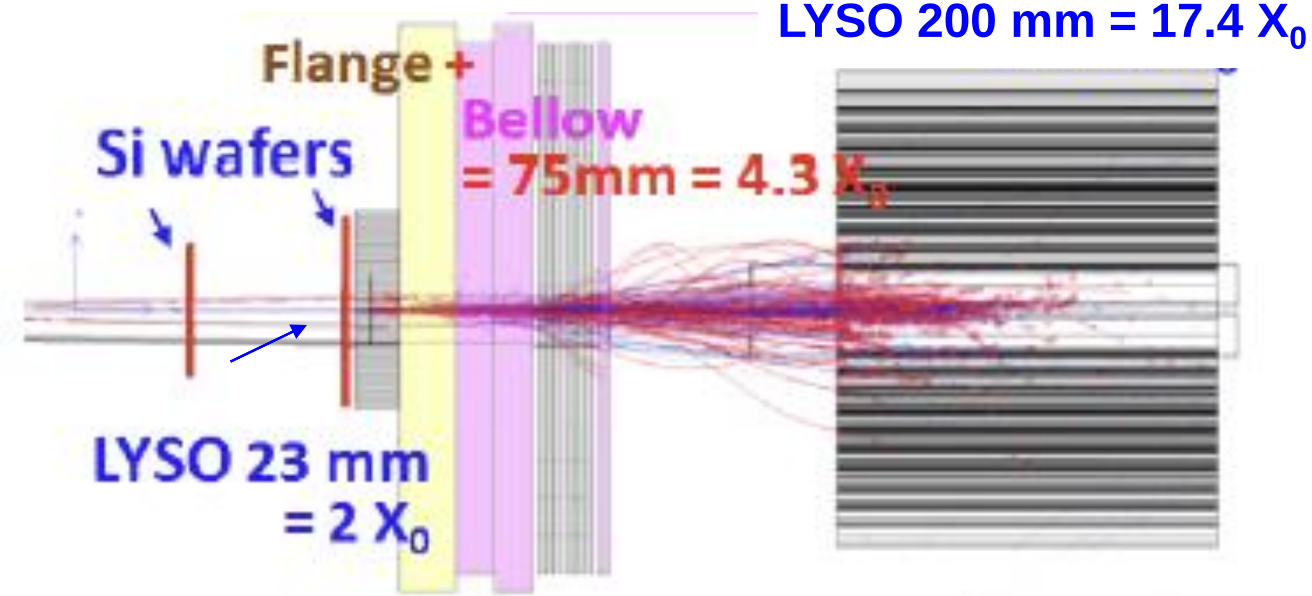




Luminosity Calorimeter

Silicon detectors to measure θ angles of e^+ and e^-

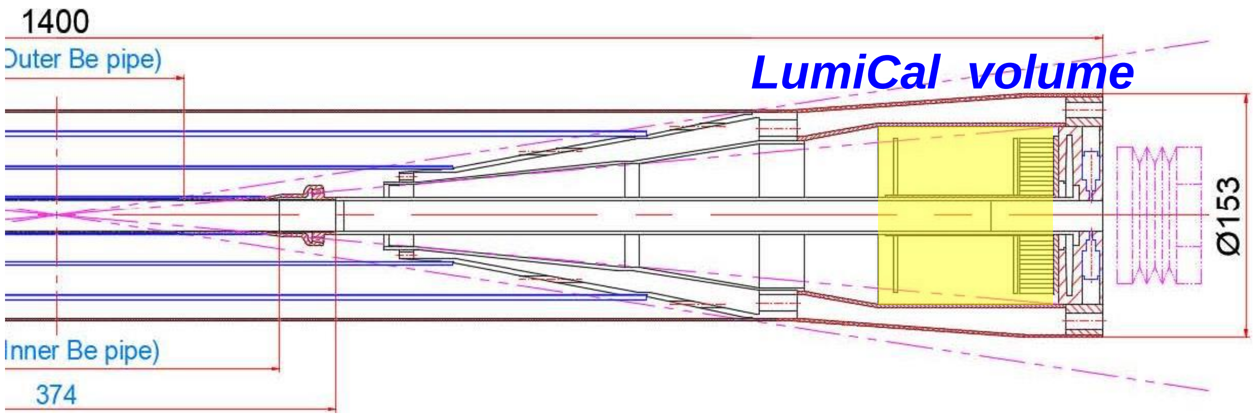
LYSO 200 mm = 17.4 X_0



LYSO bars of $10 \times 10 \times 200$ mm^3

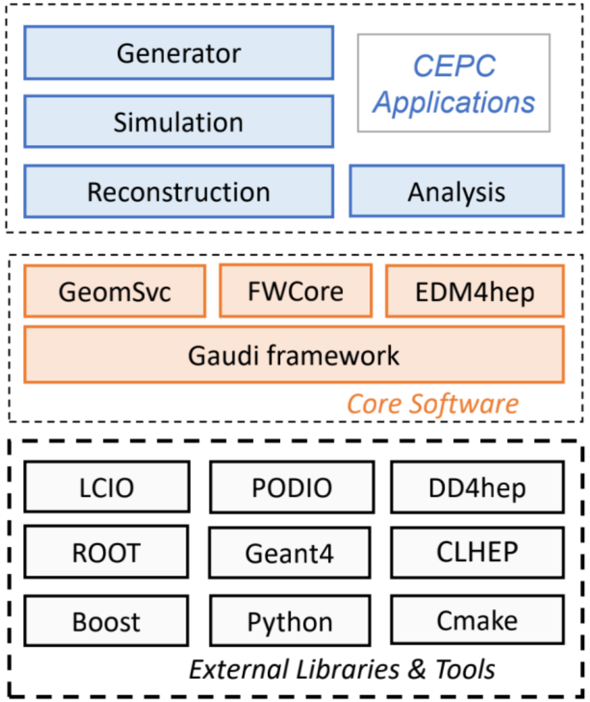
LYSO bars of $3 \times 3 \times 23$ mm^3

Z= 560-700 900 - 1100 mm



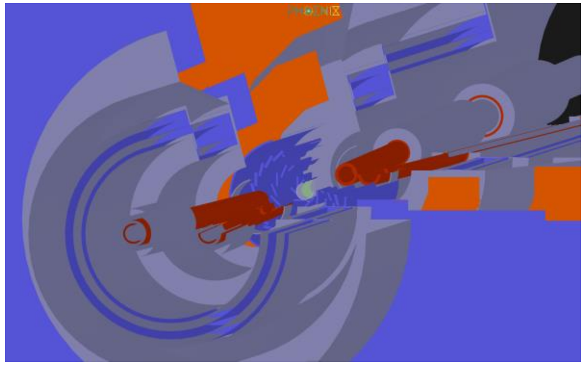
Reference: presentation by Suen Hou

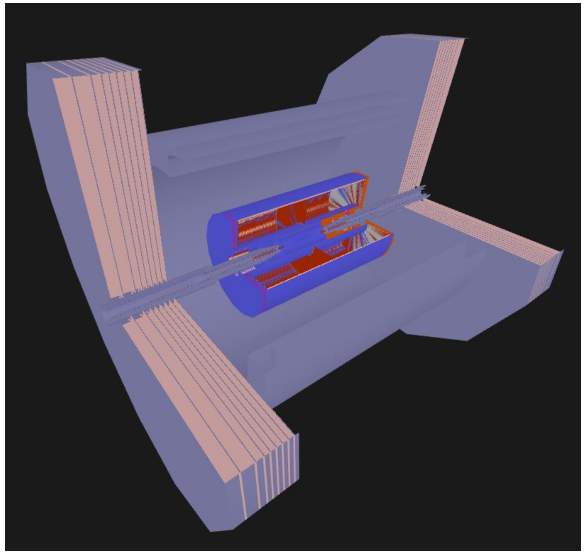
CEPC Software

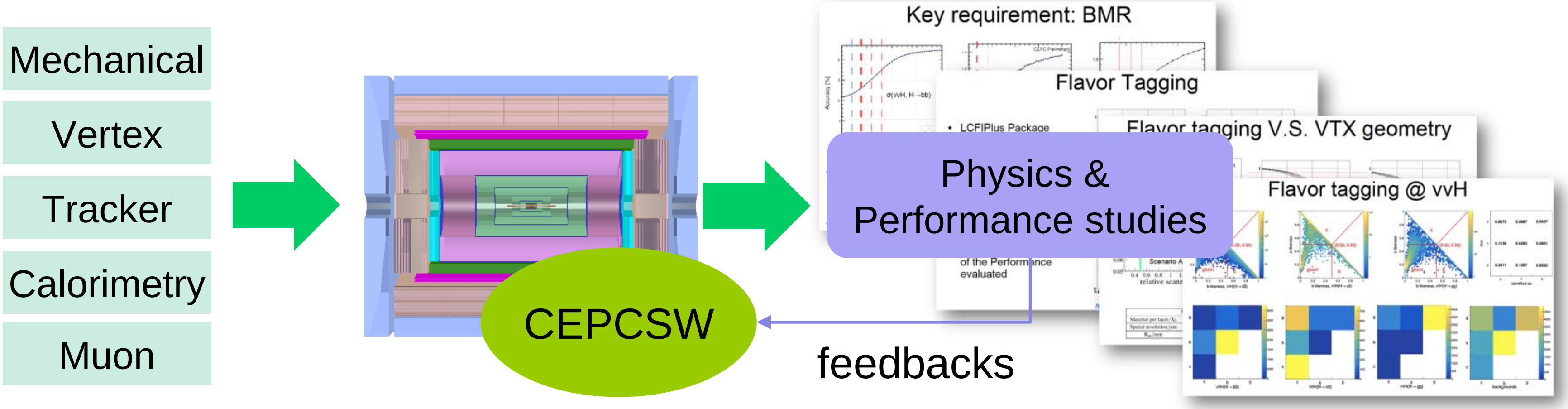


- **CEPCSW** has been developed based on components of Key4hep: Gaudi, EDM4hep, K4FWCore DD4hep
- Single source of detector information, but support multiple designs
- A web-based tool **Phoenix** for event and detector visualization

https://cepcvis.ihep.ac.cn/#/







Collaboration With Industry

CEPC 650MHz Klystron at Kunshan Co.

CERN HL-LHC CCT SC magnet

CEPC SC QD0 coil winding at KEYE Co.

CIPC (CEPC Industrial Promotion Consortium) was established in Nov 2017. So far 70+ companies have joined.

CEPC Detector SC coil winding tools at KEYE Company (Diameter ~7m)

CEPC long magnet measurement coil

1) Superconduting materials (for cavity and for magnets)
2) Superconducting cavities
3) Cryomodules
4) Cryogenics
5) Klystrons
6) Magnet technology
7)Vacuum technologies
8) Mechanical technologies
9)Electronics
10) SRF
11) Power sources
12) Civil engineering
13) Precise machinery
.....

More than 40 companies joined in first phase of CIPC, and 70 companies now.

International Efforts Towards Collaborative Experiments

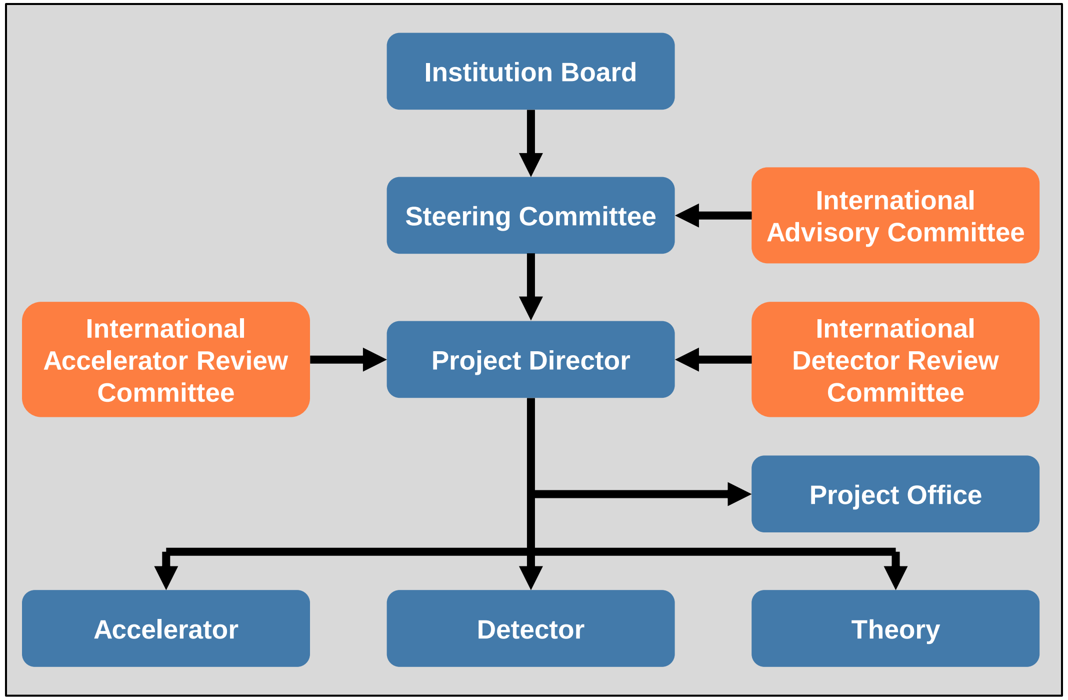


Table 7.2: Team of Leading and core scientists of the CEPC

Name	Brief introduction	Role in the CEPC team
Yifang Wang	Academician of the CAS, director of IHEP	The leader of CEPC, chair of the SC
Xinchou Lou	Professor of IHEP	Project manager, member of the SC
Yuanning Gao	Academician of the CAS, head of physics school of PKU	Chair of the IB, member of the SC
Jie Gao	Professor of IHEP	Convener of accelerator group, vice chair of the IB, member of the SC
Haijun Yang	Professor of SJTU	Deputy project manager, member of the SC
Jianbei Liu	Professor of USTC	Convener of detector group, member of the SC
Hongjian He	Professor of USTC	Convener of theory group, member of the SC
Shan Jin	Professor of NJU	Member of the SC
Nu Xu	Professor of IMP	Member of the SC
Meng Wang	Professor of SDU	Member of the SC
Qinghong Cao	Professor of PKU	Member of the SC
Wei Lu	Professor of THU	Member of the SC
Joao Guimaraes da Costa	Professor of IHEP	Convener of detector group
Jianchun Wang	Professor of IHEP	Convener of detector group
Yuhui Li	Professor of IHEP	Convener of accelerator group
Chenghui Yu	Professor of IHEP	Convener of accelerator group
Jingyu Tang	Professor of IHEP	Convener of accelerator group
Xiaogang He	Professor of SJTU	Convener of theory group
Jianping Ma	Professor of ITP	Convener of theory group

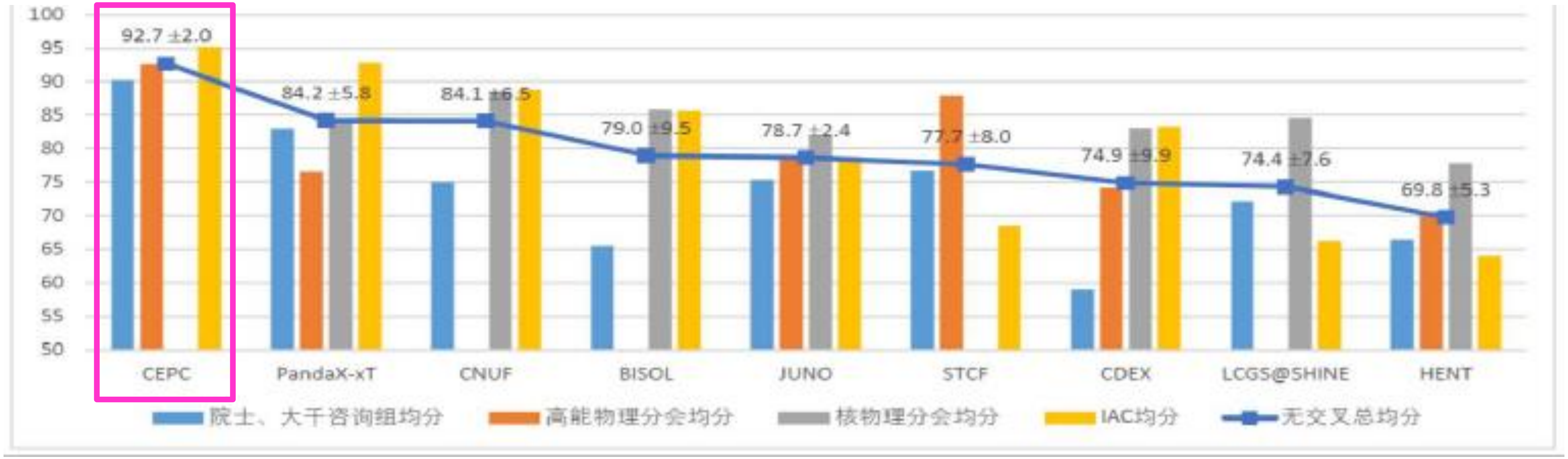
- Institution Board: 32 top domestic universities/institutes
- The International Advisory Committee (IAC) started in 2015, and held meeting yearly. The IAC members include Prof **George Hou** (2015-2022), Prof **Hann Chang** (2022-)
- Two international review committees for R&D: (IARC, IDRC) started in 2019.
- Currently the CEPC study group consists of ~1/4 international members. We hope to boost up international participation.

International Workshops

- International workshops (with emphasis on the CEPC):
  - In China: Beijing (2017.11, 2018.11, 2019.11), Shanghai (2020.10 / hybrid), Nanjing (2021.11 / online, 2022.11 / online, 2023.10), **Hangzhou (2024.10)**
  - In Europe: Rome (2018.05), Oxford (2019.04), Edinburgh (2023.07), Marseille (2024.04), **Barcelona (2025.?)**
  - In USA: Chicago (2019.09), DC (2020.04 / online)
  - Annual IAS program on HEP (HKUST) since 2015, **(2025.01.??)**
- Many topic-specific workshops at various sites

Strategic Supports

- CAS is planning for the 15th 5-year plan for large science projects. A steering committee has been established, chaired by the president of CAS.
- High energy physics and nuclear physics are one of the 8 groups.
- CEPC is **ranked No. 1**, with the smallest uncertainties, by every evaluation committee, both domestic and international one among all the collected proposals.
- The final report has been submitted to CAS for consideration.
- This process is within CAS. The following national selection process will be decisive.



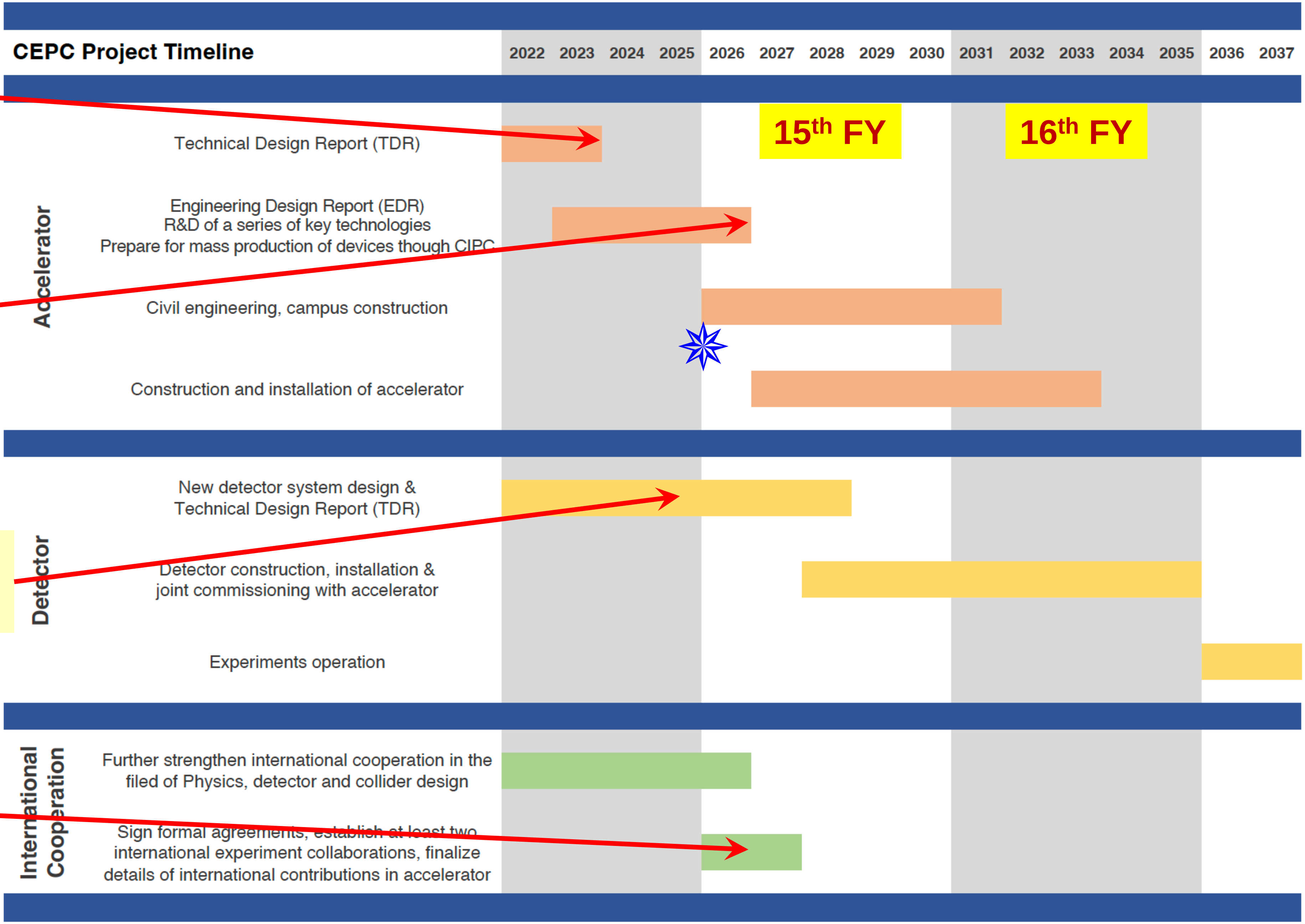
Optimal Timeline and Upcoming Events

Completion of Accelerator TDR

Completion of Accelerator EDR

TDR of a Reference Detector @ June 30, 2025

International Collaborations



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