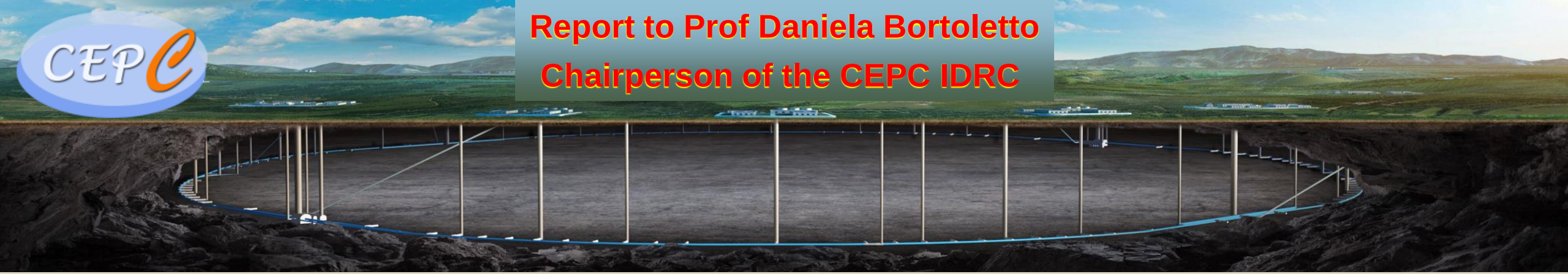


Report to Prof Daniela Bortoletto
Chairperson of the CEPC IDRC

Brief Overview of CEPC Detector Ref-TDR

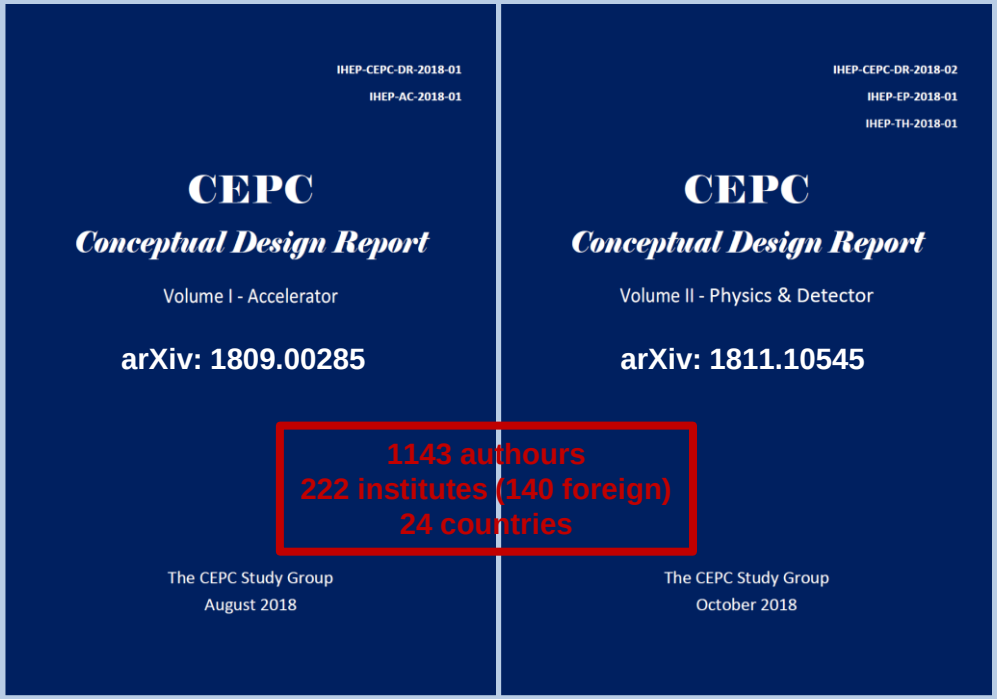
Jianchun Wang
IHEP, CAS

Content

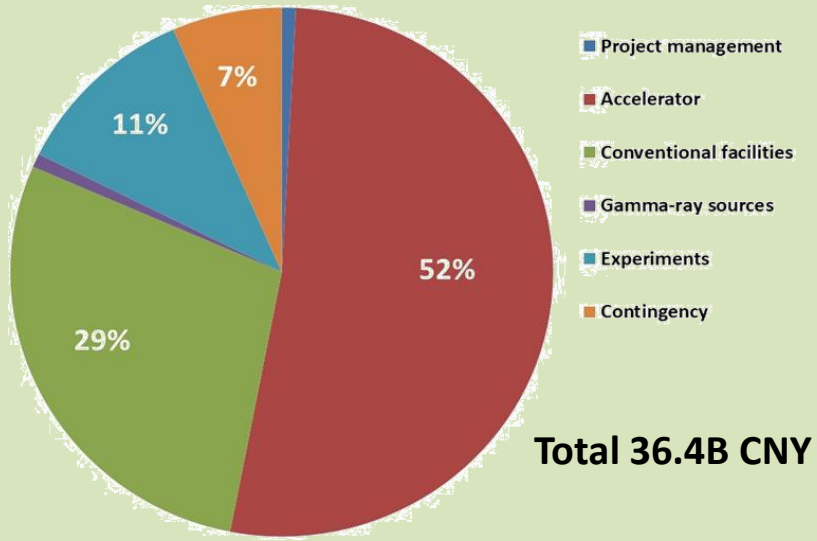
- Motivation of Ref-TDR
- Technology Selection for The Ref-TDR
- R&D Efforts and The Team
- Ref-TDR Preparation Timeline

CEPC CDR and TDR

CDR Released (2018.11)



Accelerator TDR Released (2023.12.25)



Total 36.4B CNY

TDR of a reference detector by 2025.06

Aiming for domestic endorsement

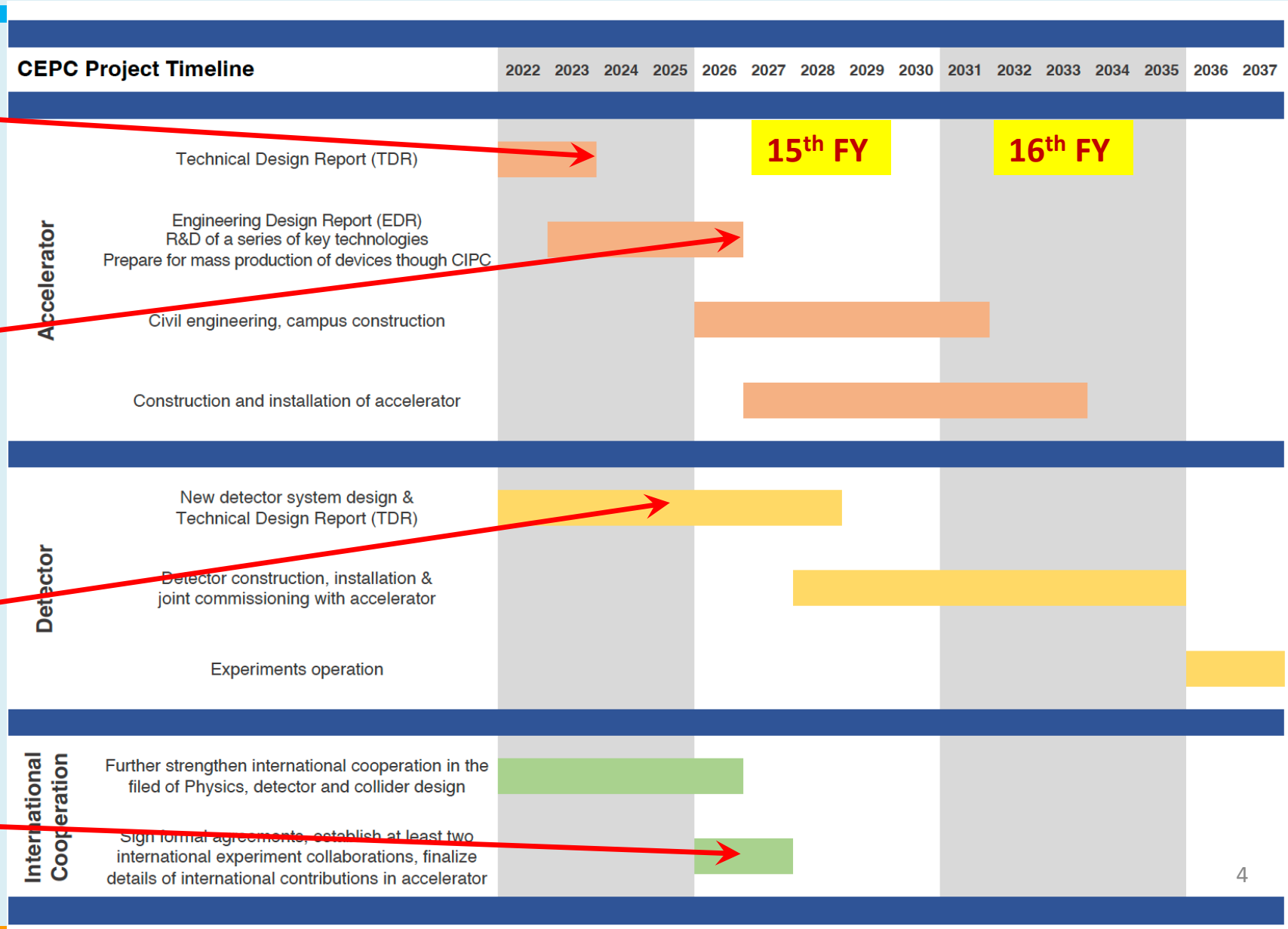
Ideal Timeline of CEPC

Completion of Accelerator TDR

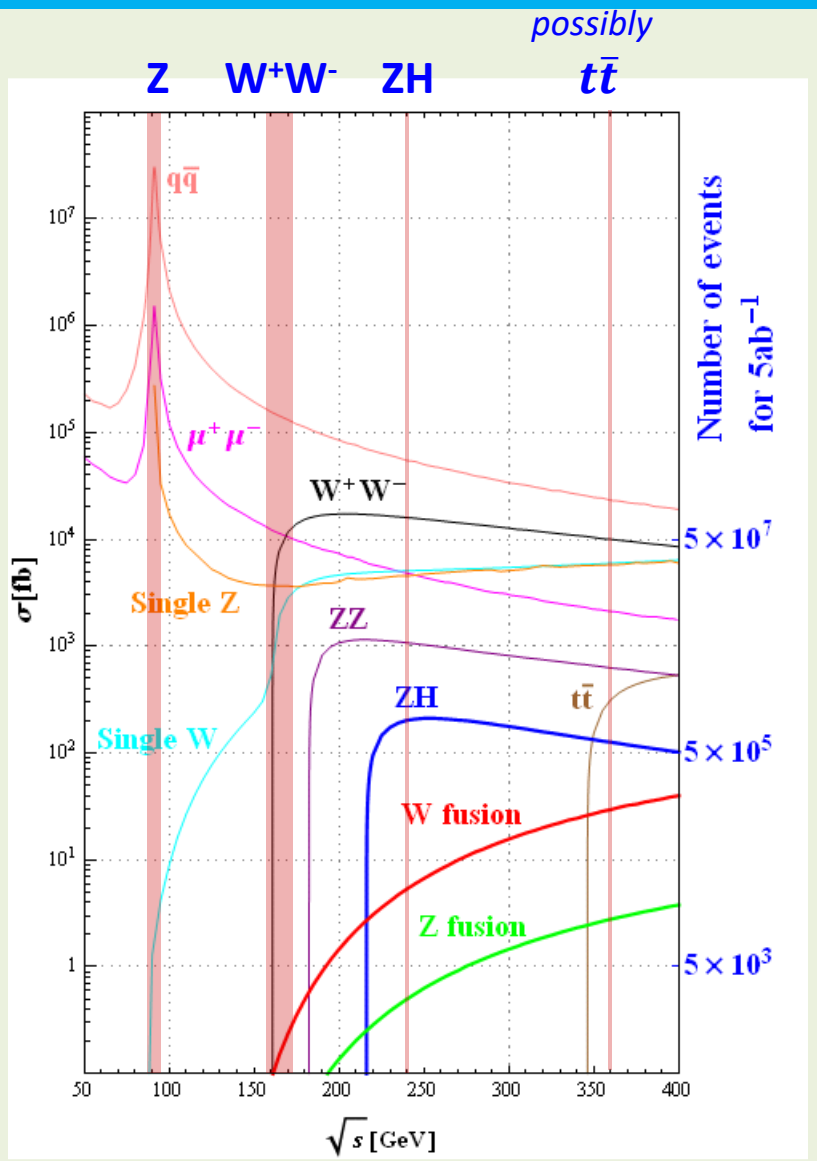
Completion of Accelerator EDR

TDR of a Ref-Detector @ June 30, 2025

International Collaborations



CEPC Operation Plan



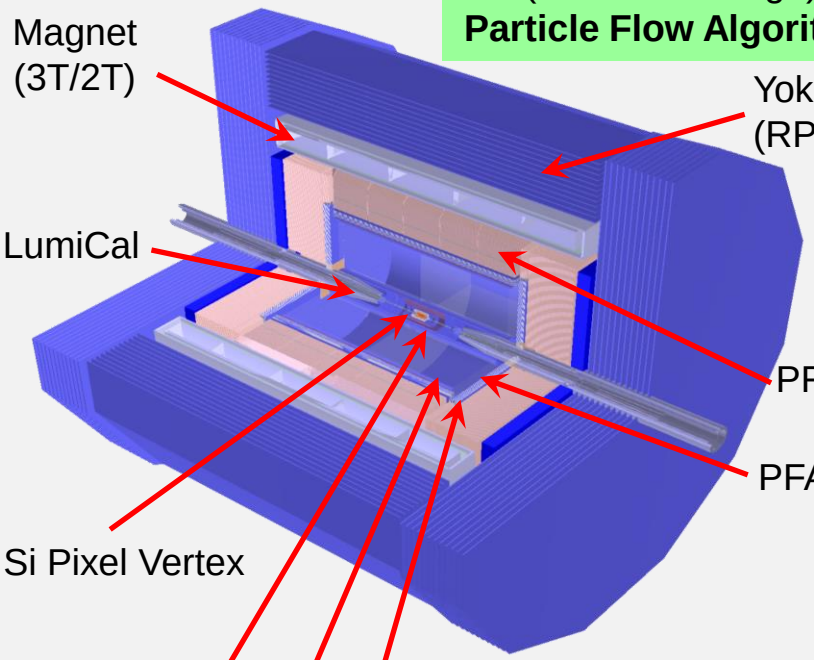
Operation mode		ZH	Z	W^+W^-	$t\bar{t}$
$\sqrt{s}$ [GeV]		~240	~91	~160	~360
Run Time [years]		10	2	1	5
30 MW	L / IP [$\times 10^{34}$ cm^{-2}s^{-1}]	**5.0**	**115**	**16**	**0.5**
	$\int L\,dt$ [ab^{-1}, 2 IPs]	13	60	4.2	0.65
	Event yields [2 IPs]	2.6×10^6	2.5×10^{12}	1.3×10^8	4×10^5
50 MW	L / IP [$\times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

CEPC accelerator TDR (Xiv:2312.14363)

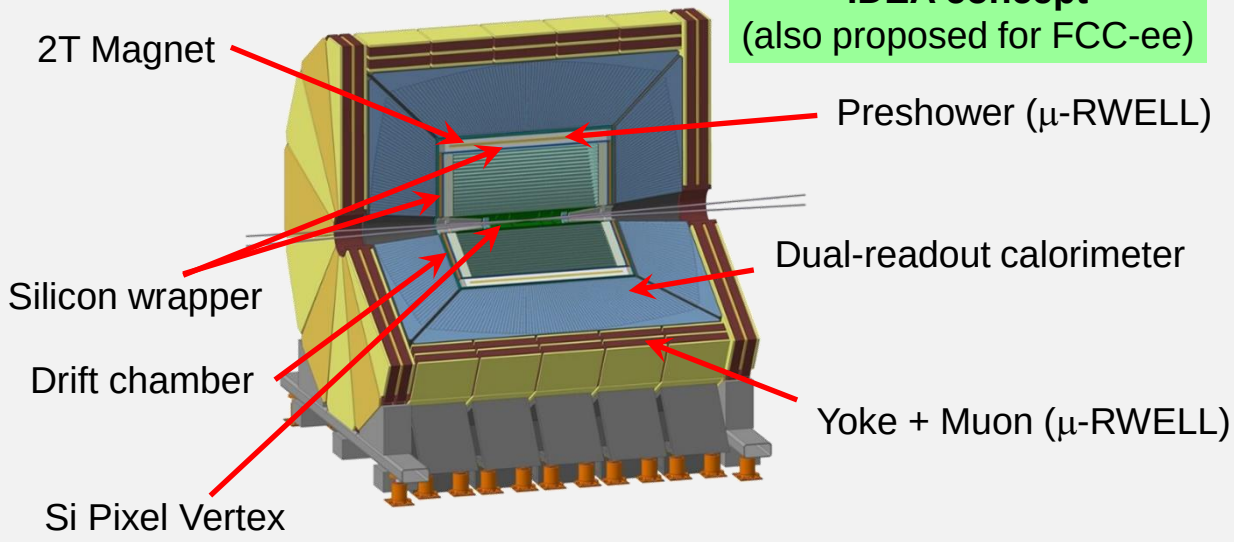
While aiming to meet the needs of the whole energy range, emphasizes more on the Higgs operation mode.

Conceptual Detector Design

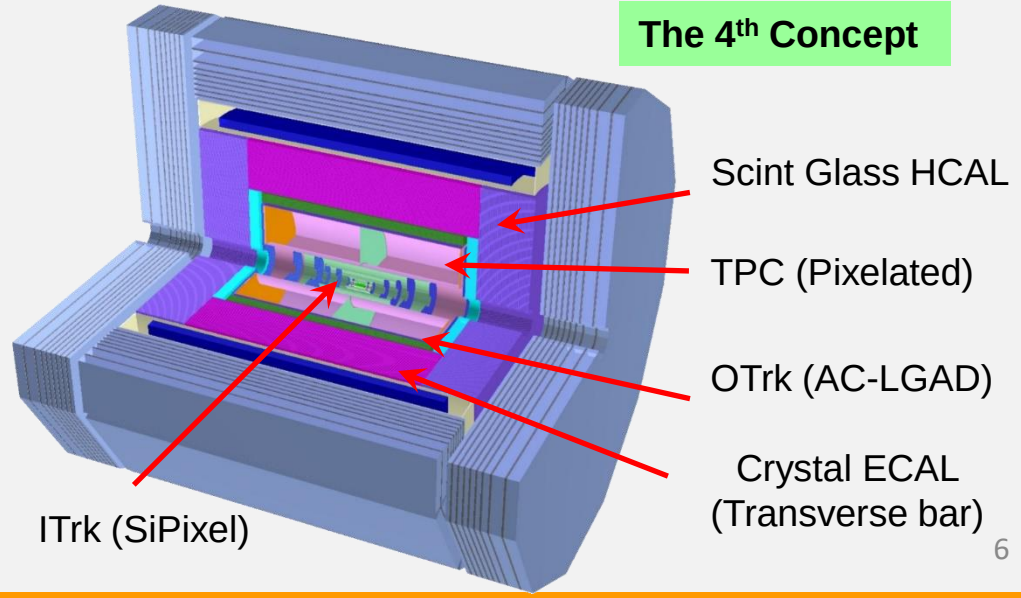
(Baseline Design)
Particle Flow Algorithm



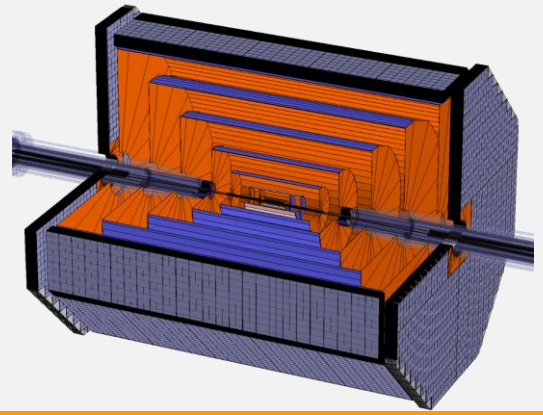
IDEA concept
(also proposed for FCC-ee)



The 4th Concept



FST concept
(Full Silicon Tracker)

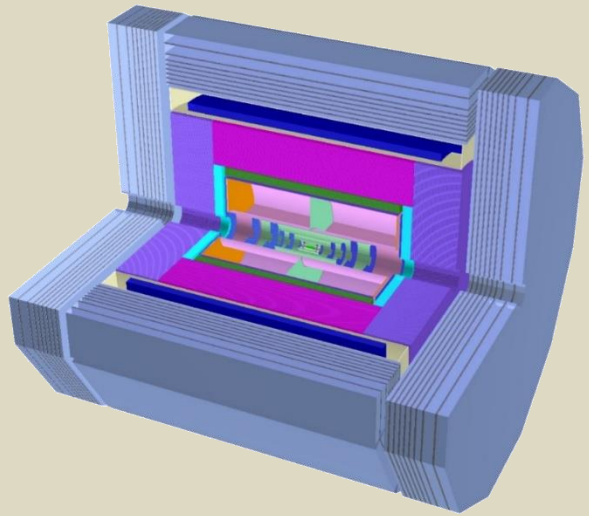


Technologies For Ref-TDR

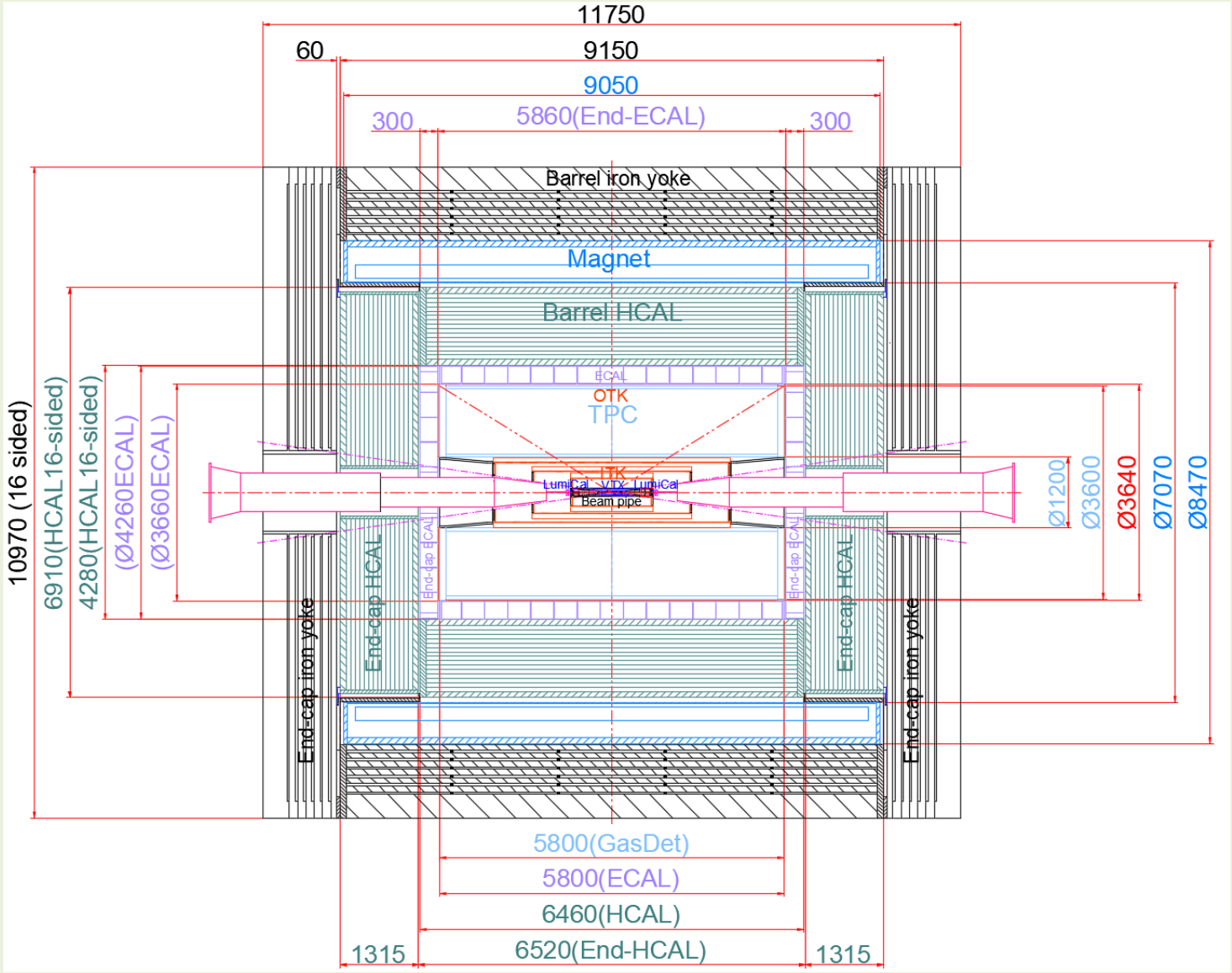
System	Technologies	
	Baseline	For comparison
Beam pipe	Φ20 mm	
LumiCal	SiTrk+Crystal	
Vertex	CMOS+Stitching	CMOS Pixel
Tracker	CMOS SiDet ITrk	
	Pixelated TPC	PID Drift Chamber
	AC-LGAD OTrk	SSD / SPD OTrk
		LGAD ToF
ECAL	4D Crystal Bar	PS+SiPM+W, GS+SiPM, etc
HCAL	GS+SiPM+Fe	PS+SiPM+Fe, etc
Magnet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

R

- The CEPC study group started to compare different technologies in January, 2024
- By the end of June, 2024 the baseline technologies were chosen.
- Multiple factors were considered in the process: performance, cost, R&D efforts, technology maturity, …



Geometry and Mechanical Support

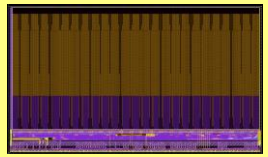


Subsystem	Supported By
Barrel Yoke	Base
Magnet	Barrel Yoke
Barrel HCAL	Barrel Yoke
Barrel ECAL	Barrel HCAL
TPC+ Barrel OTK	Barrel ECAL
ITK	TPC
Beampipe+VTX+LumiCal	ITK
Endcap Yoke	Base
Endcap HCAL	Barrel HCAL
Endcap ECAL+OTK	Barrel HCAL

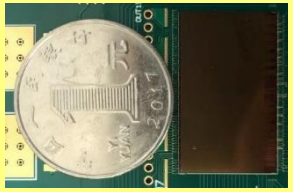
Detector R&D Efforts (I)

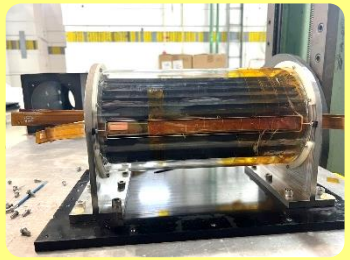
Pixel Vertex

JadePix4

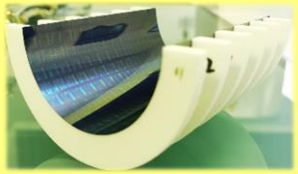


TaichuPix3



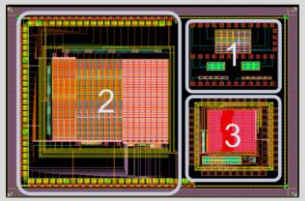


Prototype VTX



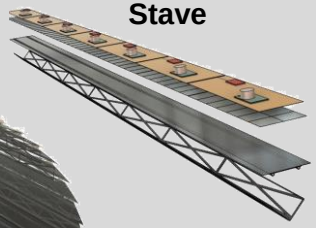
Curved MAPS

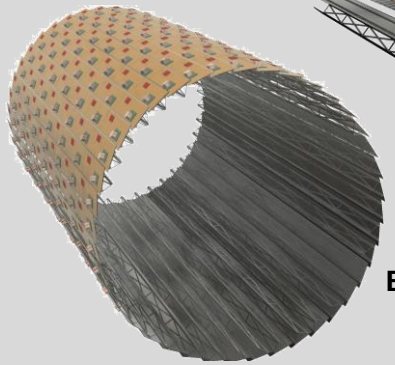
HV-CMOS Tracker



55nm COFFEE chip

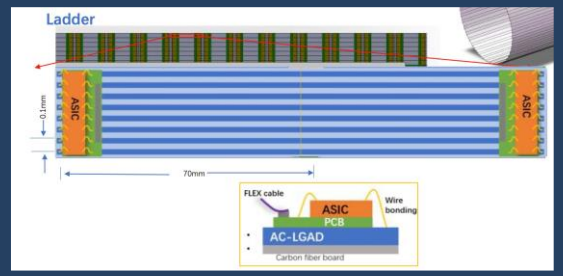
Stave



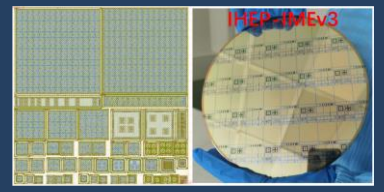


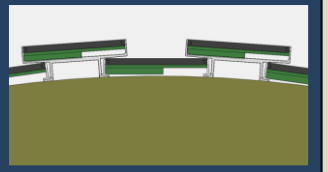
Barrel

AC-LGAD Tracker

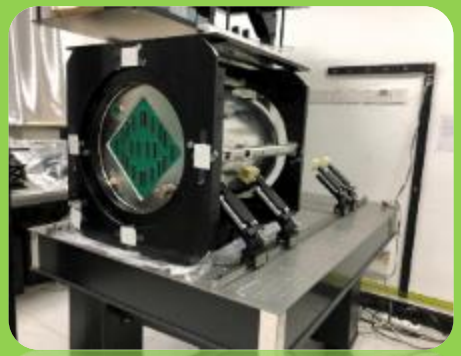


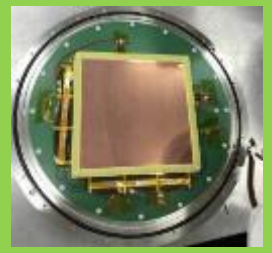
LGAD



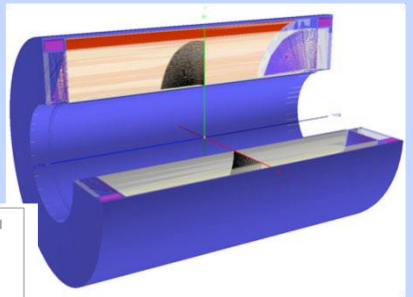


TPC Prototype



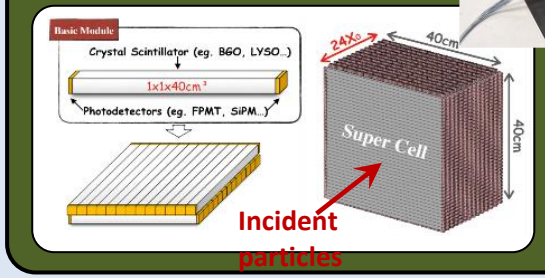


PID Drift Chamber

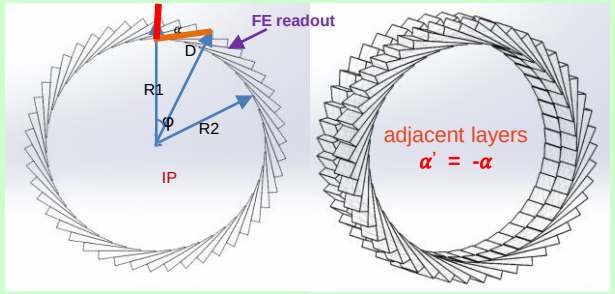


Detector R&D Efforts (II)

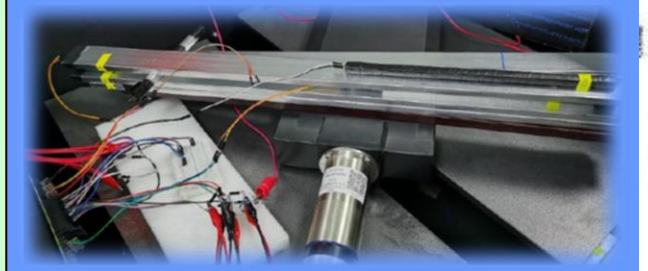
4D Crystal Bar ECAL

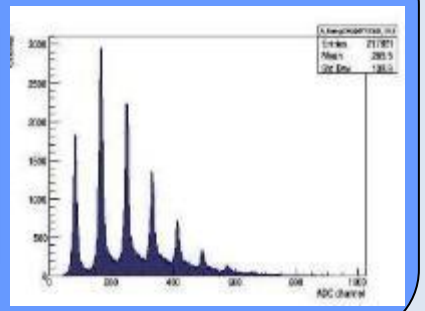


Stereo Crystal ECAL

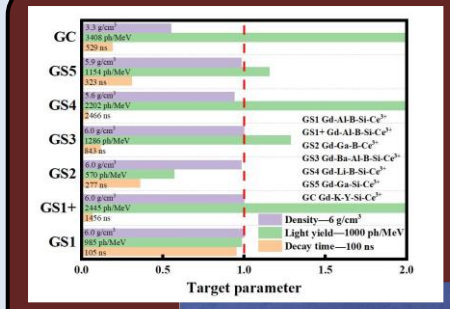


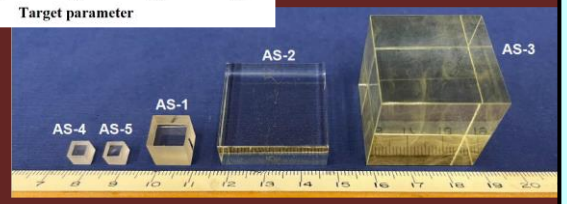
Scintillator Bar Muon



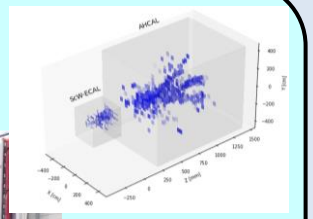


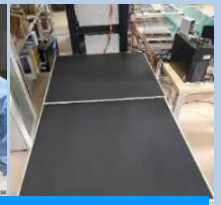
Glass Scintillator

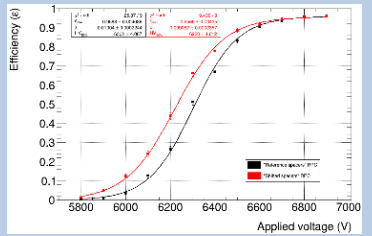




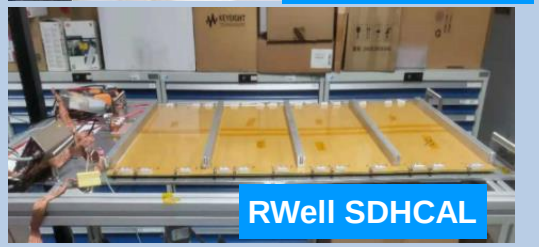
Prototype sampling ECAL & HCAL



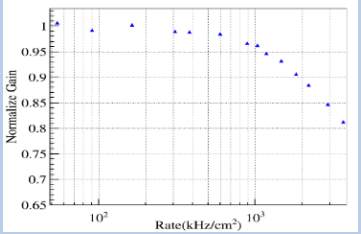




GRPC SDHCAL



RWell SDHCAL



International Collaborative Efforts

- The detector design incorporates experience from other future Higgs factory proposals, e.g. ILD.

- International detector R&Ds
  - Some detector R&D efforts were within the international detector R&D collaborations, e.g. CALICE, LCTPC, & RD*
  - Much broader participation now in the ECFA DRD program

- Strong collaborative efforts (*details in the following presentations*)
  - International participations in subdetector R&Ds, e.g. MAPS detector, TPC, PID DC, …
  - Experienced domestic team:

    Key members of China-based experiments: BES, DYBay, LHAASO, JUNO, …

    Fast rising importance in major experiments: ATLAS, CMS, LHCb, ALICE, AMS, …

Document Preparation of Ref-TDR

- The ref-TDR has 16 chapters, which may be re-structured later.
- Each chapter has a responsible team, including members from domestic and international institutes.
- Prof Tianchi Zhao kindly agreed to be the chief editor. A small editorial team will assist him

Report at this meeting

1) Physics goal and requirements
2) Concept introduction
3) Vertex detector
4) Silicon trackers
5) Gaseous trackers
6) Electron magnetic calorimeter
7) Hadron calorimeter
8) Muon detector
9) Magnet
10) MDI and beam measurement
11) General electronics
12) TDAQ and online
13) Software and computing
14) Mechanics, integration and installation
15) Global performance
16) Overall cost and timeline

Ref-TDR Timeline

Date	Actions and/or Expectations
Jan 1, 2024	Start the ref-TDR process by comparing different technologies
Jul 1, 2024	Baseline technologies are chosen; start to write TDR and address key issues
Aug 7, 2024	Report to the IDRC chair Prof Daniela Bortoletto
Oct 21-23, 2024	Review of ref-TDR progress by the IDRC
Oct 23-30, 2024	Discuss the ref-TDR at the CEPC workshop, report progresses to the CEPC IAC
Dec 31, 2024	The first draft of the ref-TDR is ready for internal reviews
April 30, 2025	Finish international reviews
Jun 30, 2025	The ref-TDR is ready

Thank you for your attention!

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Institute of High Energy Physics
Chinese Academy of Sciences