Circular Electron Positron Collider

Exploring the TeV scale with high-precision experiments

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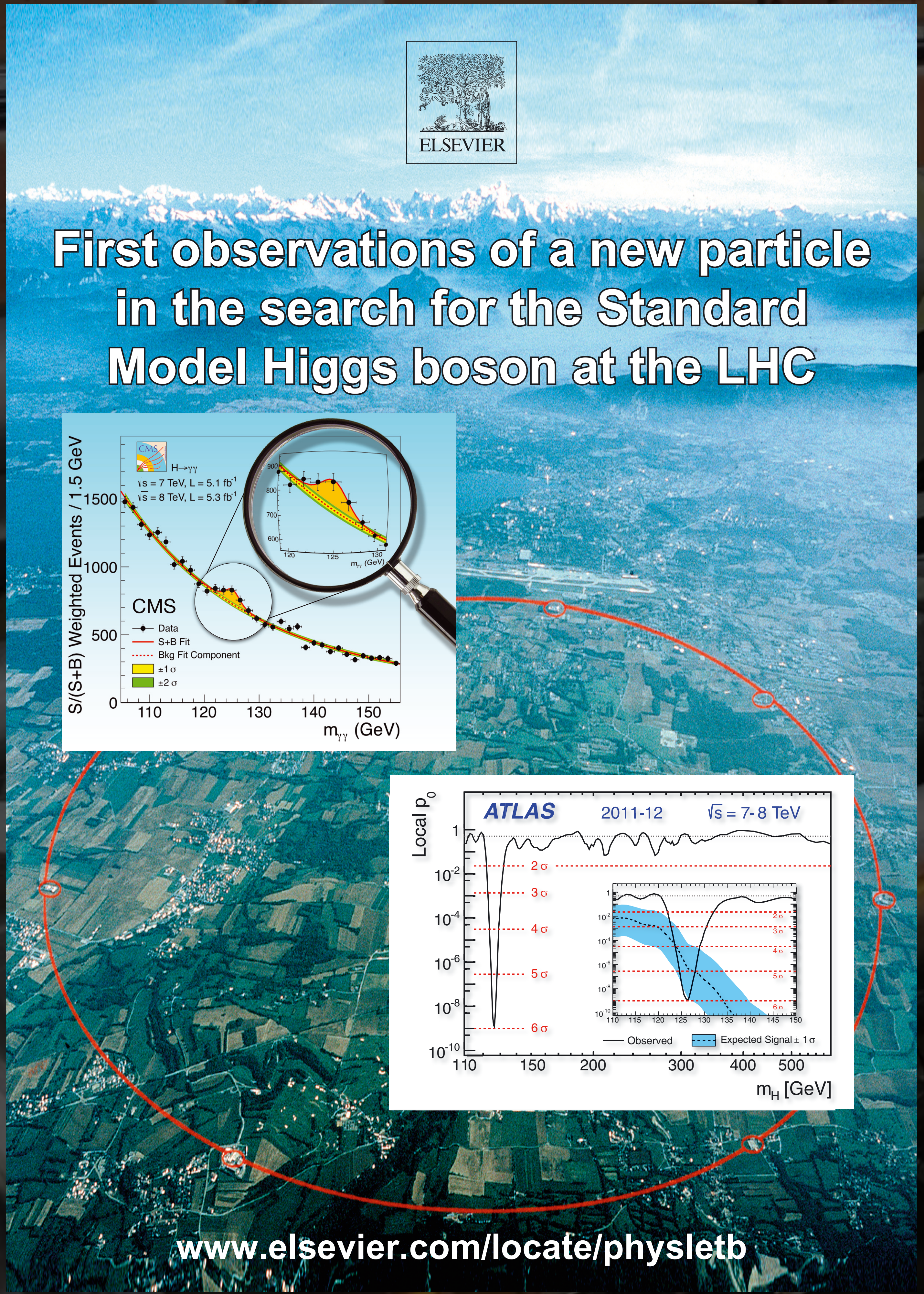
The Higgs Boson Discovery at LHC

Predicted in 1964, discovered in 2012! 48 year hunting!

An effort by tens of thousands scientists and engineers from all over the world

ATLAS & CMS Observation



2013 Nobel Prize

François Englert and Peter Higgs

Huge impact to humanity

Technology
Cultural
International Collaboration

What is the next step for HEP?

Higgs as a special probe

$$\mathcal{L}_{Higgs} = (D_\mu \phi)^\dagger (D^\mu \phi) - V(\phi^\dagger \phi) - \overline{\psi}_L \Gamma \psi_R \phi - \overline{\psi}_R \Gamma^\dagger \psi_L \phi^\dagger$$

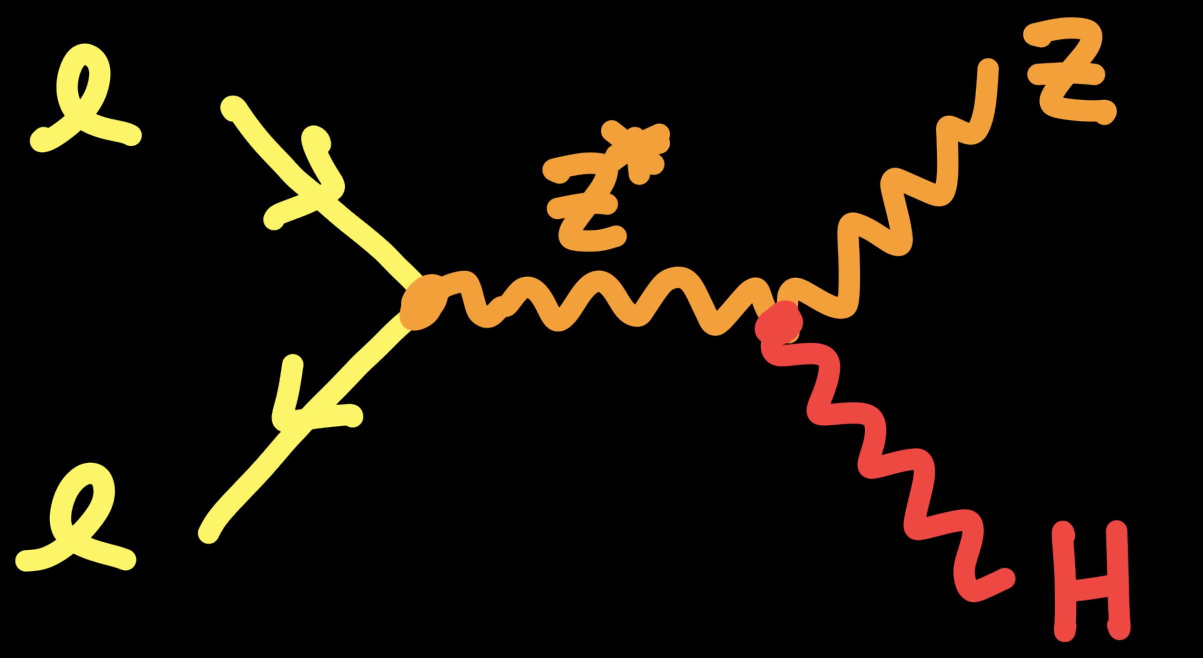
$$V(\phi^\dagger \phi) = -\frac{m_H^2}{2} \phi^\dagger \phi + \frac{1}{2} \lambda (\phi^\dagger \phi)^2$$

$$\lambda = \frac{m_H^2}{2v^2}$$

- **Measure Higgs properties with highest precision**
  - Many different couplings fixed by masses, yukawa hierarchy?
    - Have neutrinos a special role?
  - λ determines shape and evolution of the Higgs potential → cosmological implications
  - New dark states? → Portal to new physics beyond SM
  - Search for rare processes, through high-accuracy studies of SM cross sections

e^+e^- colliders offer clear advantages due to the potentially high accuracy of measurements

Revived e^+e^- Circular Colliders



Relatively low Higgs mass:
m_H = 125 GeV

LEP stopped taking data in 2000 limited by synchrotron energy loss
Center mass energy: $\sqrt{s}$ = 209 GeV

Just a few GeV below the required energy to produce Higgs events copiously
$\sqrt{s}$ = 240 GeV

Synchrotron energy loss

$$\frac{240\ \mathrm{GeV}}{209\ \mathrm{GeV}} \sim 1.14$$

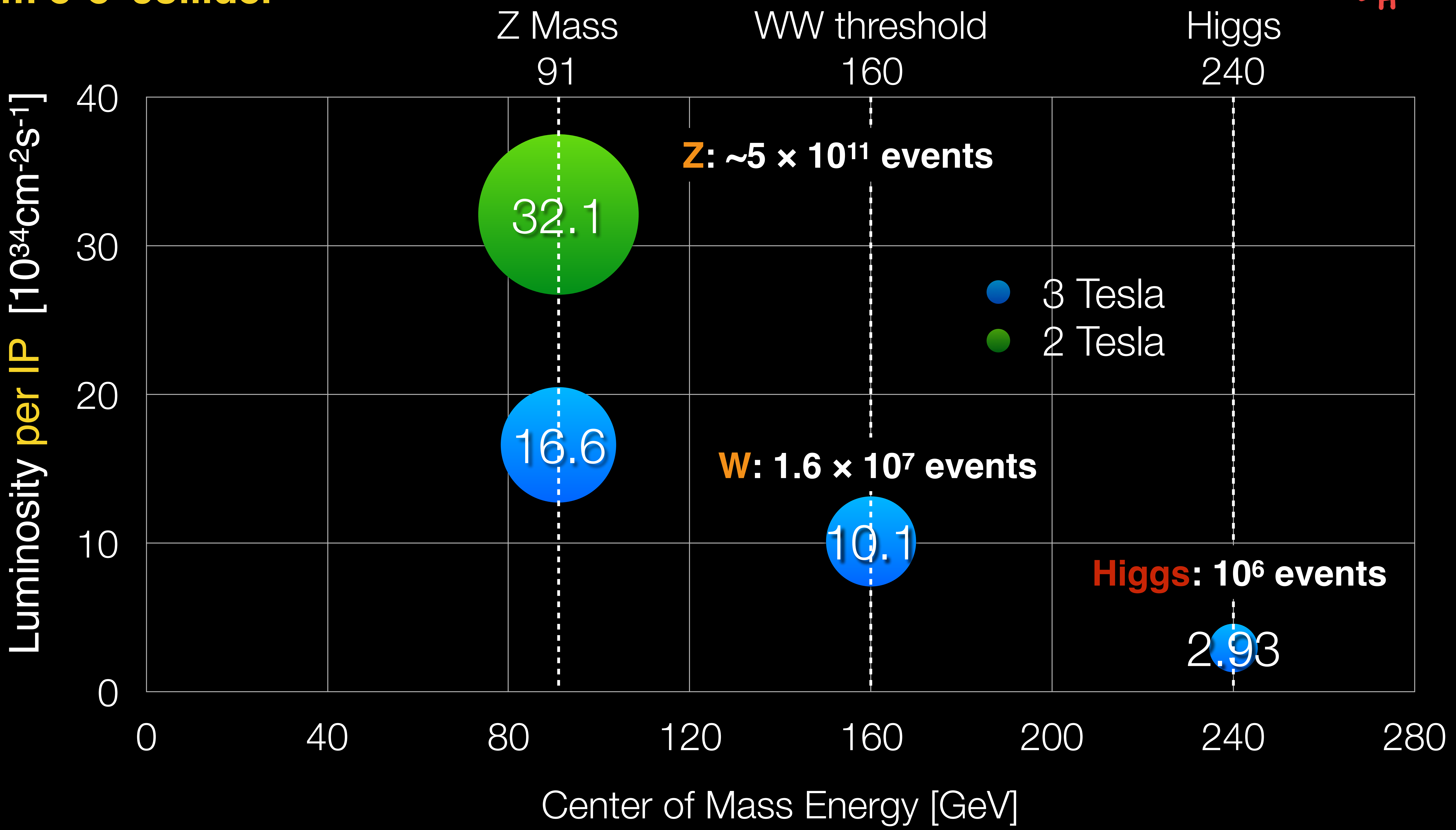
$$\frac{E^4}{r} = \frac{1.14^4}{3.5} \sim 0.5$$

radius increased by 3.5×

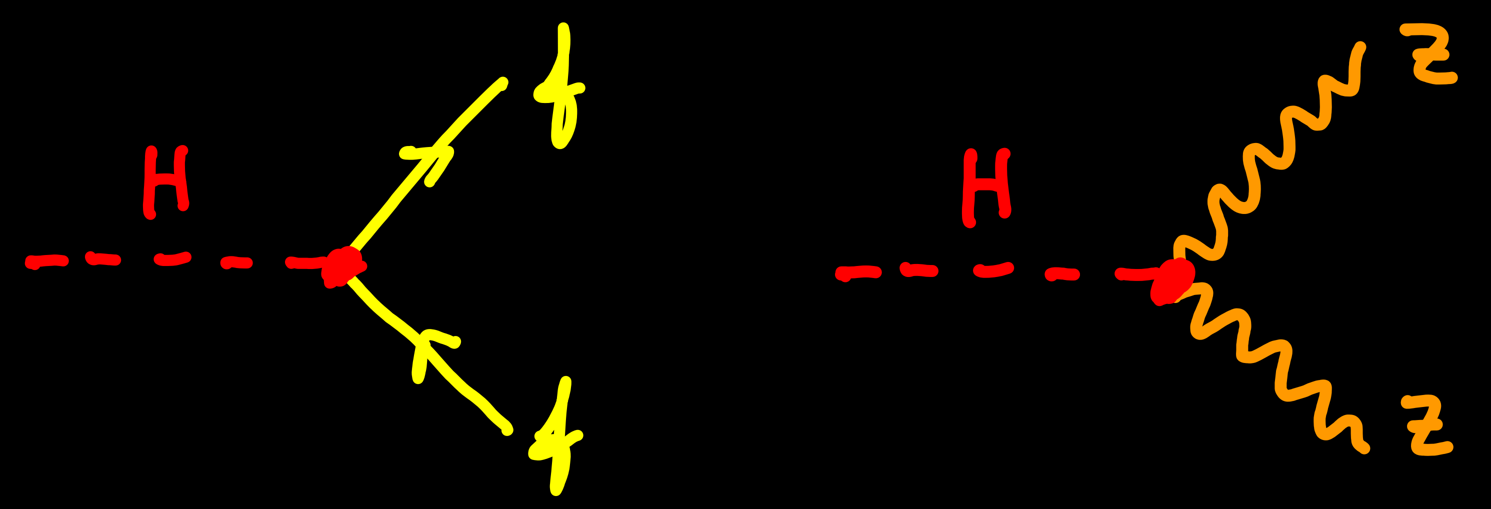
~100 km accelerator adequate for Higgs studies

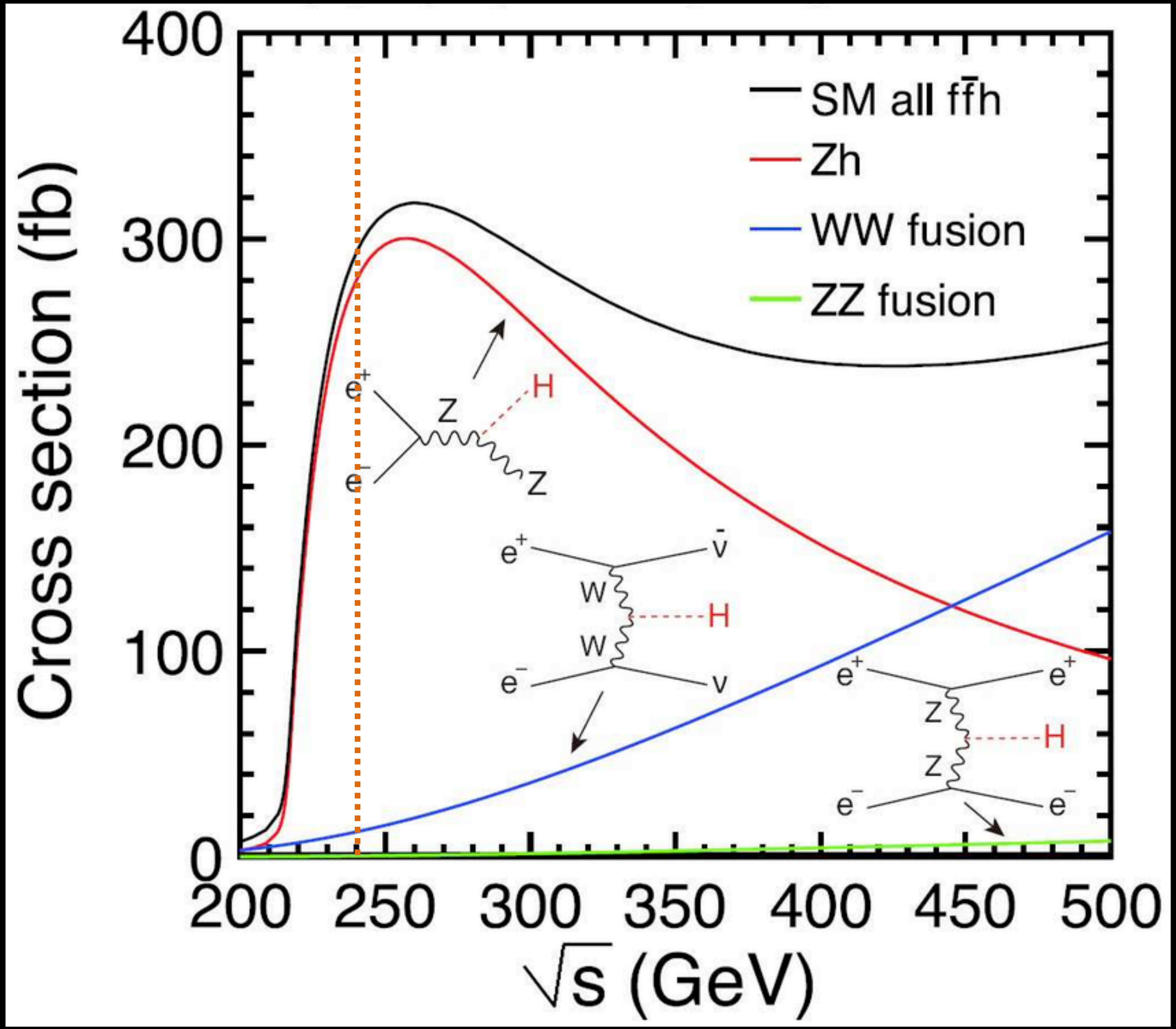
The CEPC Program

100 km e^+e^- collider



Higgs production in e^+e^- collisions





Events at 5 ab^{-1}

ZH: 10^6 events

vvH: 10^4 events

e^+e^-H: 10^3 events

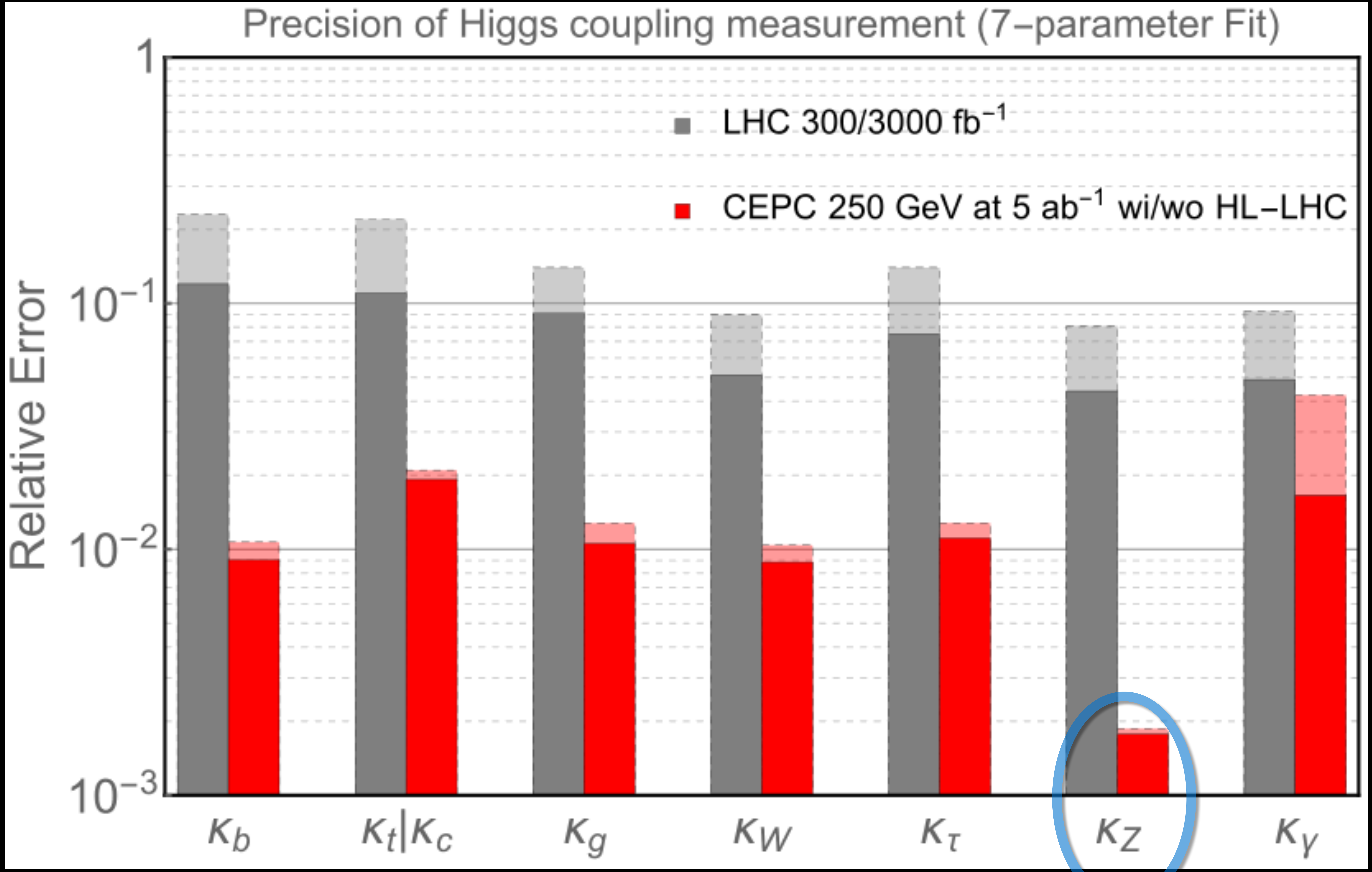
S/B
1:100-1000

Observables:
Higgs mass, CP, σ(ZH),
event rates (σ(ZH, vvH)*Br(H→X)),
Differential distributions

Extract:
Absolute Higgs width,
couplings

Higgs Couplings Measurement

Precision of Higgs couplings measurement compared to HL-LHC

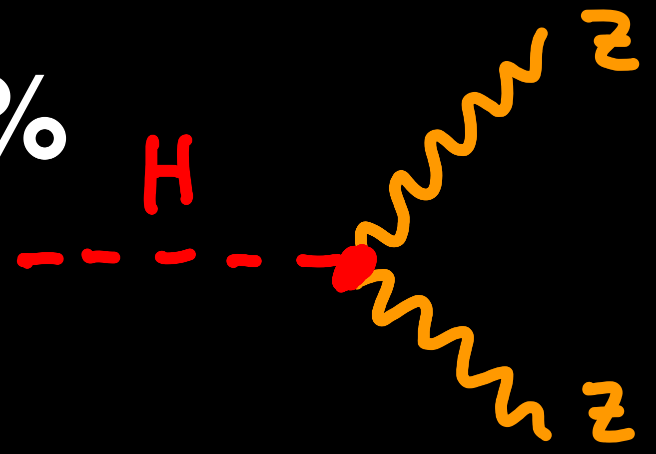


$$\kappa_f = \frac{g(hff)}{g(hff;\mathrm{SM})}, \quad \kappa_V = \frac{g(hVV)}{g(hVV;\mathrm{SM})}$$

HL-LHC

CEPC
~1% uncertainty

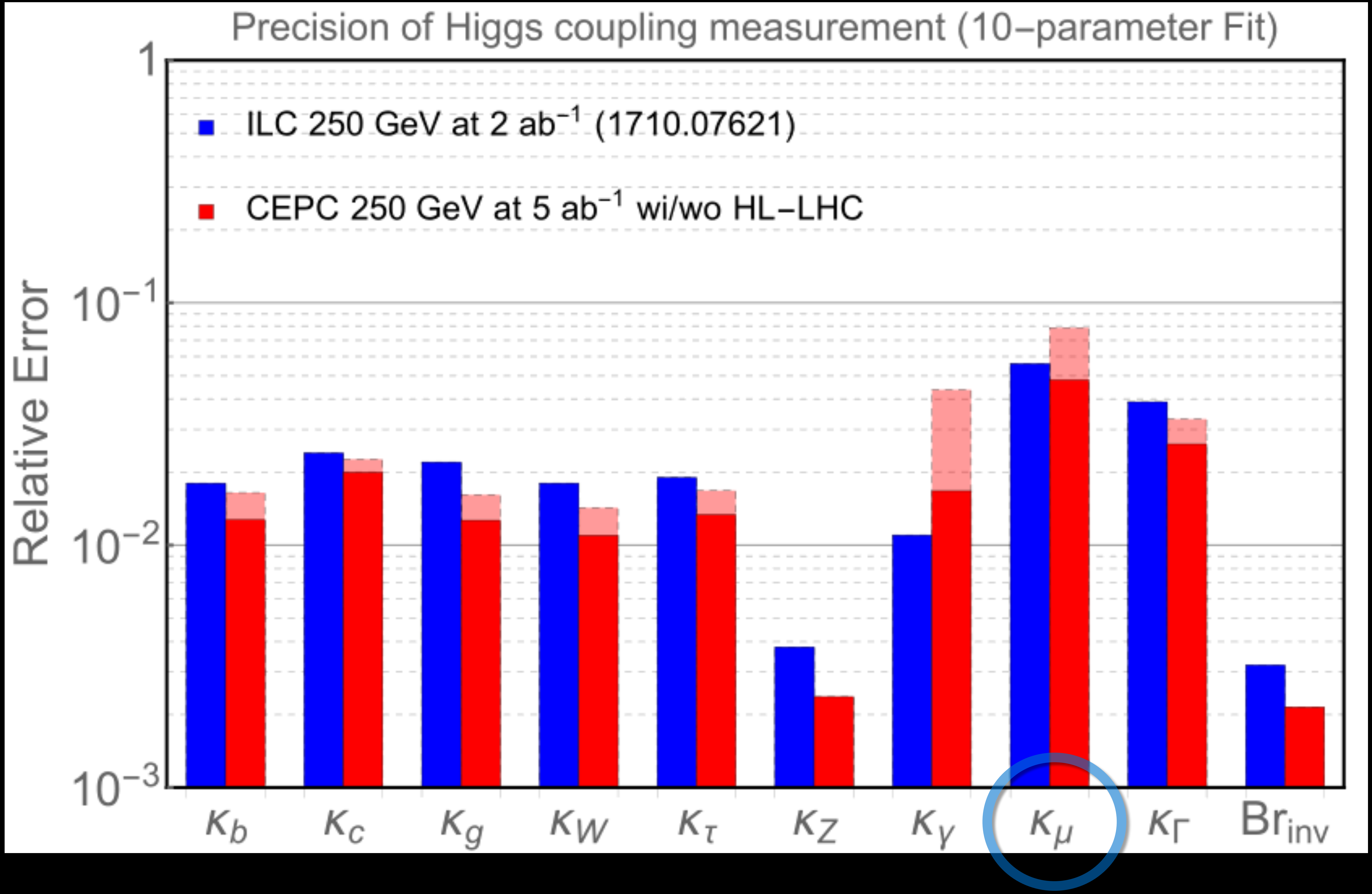
K_Z ~ 0.2 %



ATL-PHYS-PUB-2014-016

Higgs Couplings Measurement

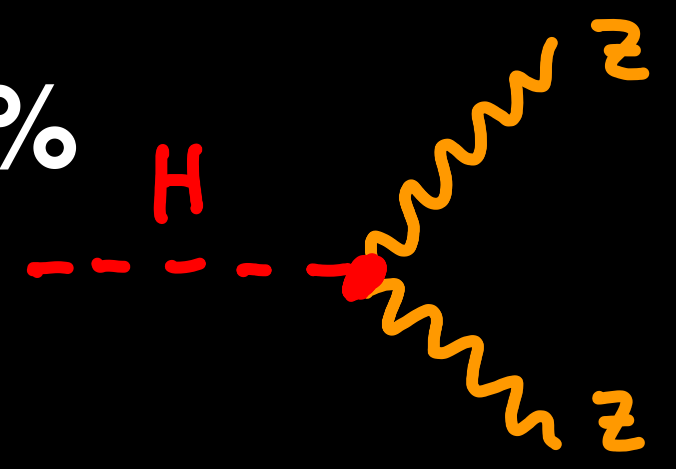
Precision of Higgs couplings measurement compared to ILC



$$\kappa_f = \frac{g(hff)}{g(hff;\mathrm{SM})}, \quad \kappa_V = \frac{g(hVV)}{g(hVV;\mathrm{SM})}$$

ILC
CEPC
~1% uncertainty

$K_Z \sim 0.2$ %



ATL-PHYS-PUB-2014-016

Many BSM models impact Higgs couplings at percentage level

CEPC will be sensitive to these

	Model	$b\bar{b}$	$c\bar{c}$	gg	WW	$\tau\tau$	ZZ	$\gamma\gamma$	$\mu\mu$
1	MSSM [38]	+4.8	-0.8	- 0.8	-0.2	+0.4	-0.5	+0.1	+0.3
2	Type II 2HD [39]	+10.1	-0.2	-0.2	0.0	+9.8	0.0	+0.1	+9.8
3	Type X 2HD [39]	-0.2	-0.2	-0.2	0.0	+7.8	0.0	0.0	+7.8
4	Type Y 2HD [39]	+10.1	-0.2	-0.2	0.0	-0.2	0.0	0.1	-0.2
5	Composite Higgs [40]	-6.4	-6.4	-6.4	-2.1	-6.4	-2.1	-2.1	-6.4
6	Little Higgs w. T-parity [41]	0.0	0.0	-6.1	-2.5	0.0	-2.5	-1.5	0.0
7	Little Higgs w. T-parity [42]	-7.8	-4.6	-3.5	-1.5	-7.8	-1.5	-1.0	-7.8
8	Higgs-Radion [43]	-1.5	- 1.5	+10.	-1.5	-1.5	-1.5	-1.0	-1.5
9	Higgs Singlet [44]	-3.5	-3.5	-3.5	-3.5	-3.5	-3.5	-3.5	-3.5

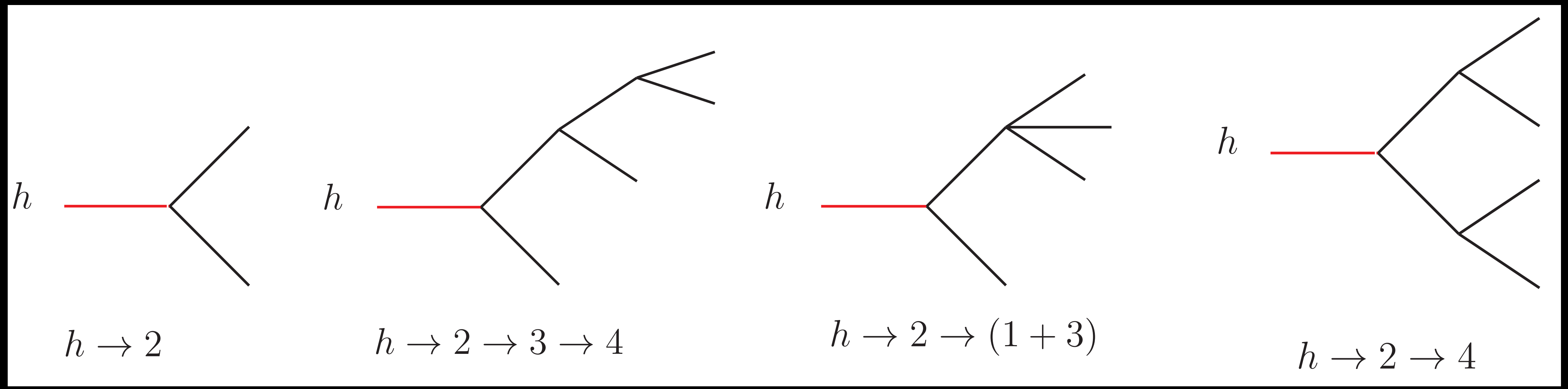
LHC not likely to be sensitive to these models even with full HL-LHC dataset

arXiv: 1710.07621

BSM Physics through Exotic Higgs Decays

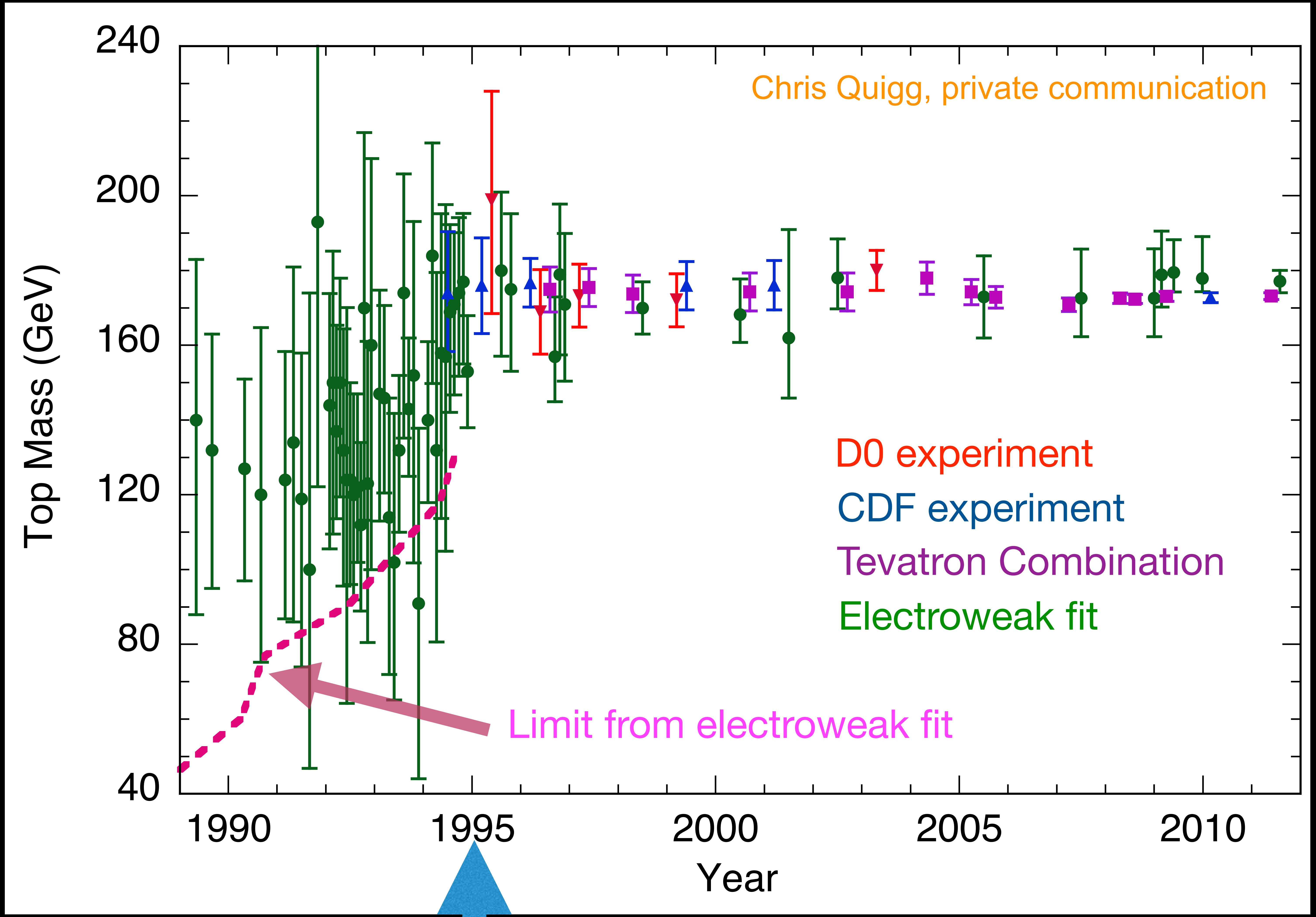
General search for BSM

e^+e^- collider better than HL-LHC for MET+hadronic activity final states



Z. Liu, H. Zhang, LT Wang, 1612.09284

Top Mass Prediction from Precision Electroweak data



M_{top} = 175 —> 173 GeV

Current world average:
m_{top} = 173.1 ± 0.6 GeV
(0.35%)

Top discovery at Tevatron

Higgs Mass Prediction from Precision Electroweak data

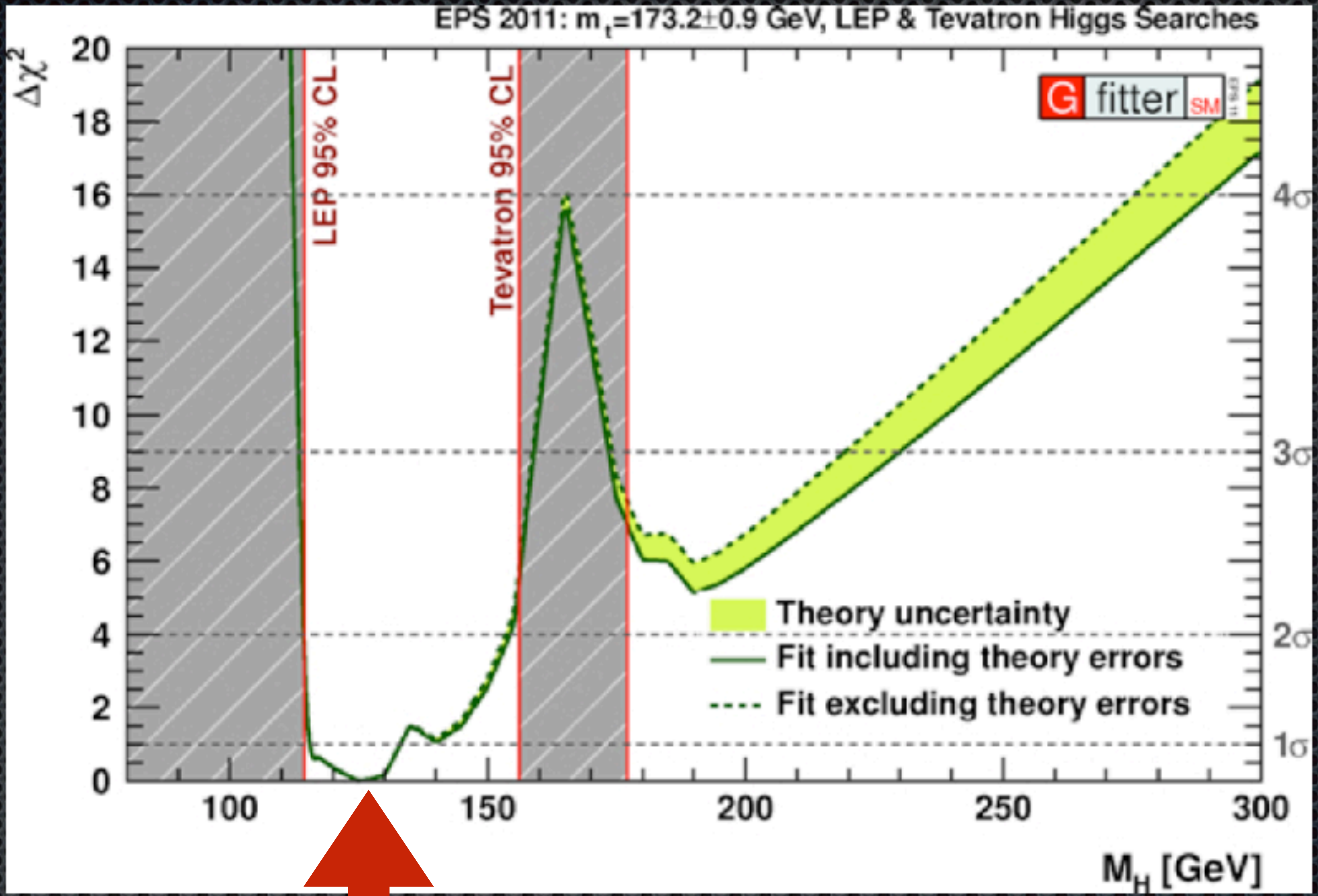
and some extra help!

PANIC 2011, July 28, 2011

Overnight update

WARNING: Old Slide

- **Updated with EPS'01 results**
  - Excludes direct searches from ATLAS and CMS from EPS



Standard Fit

m_H (minimum)= 94.5 GeV, Range m_H = [71, 124], m_H < 166.5 GeV @ 95%

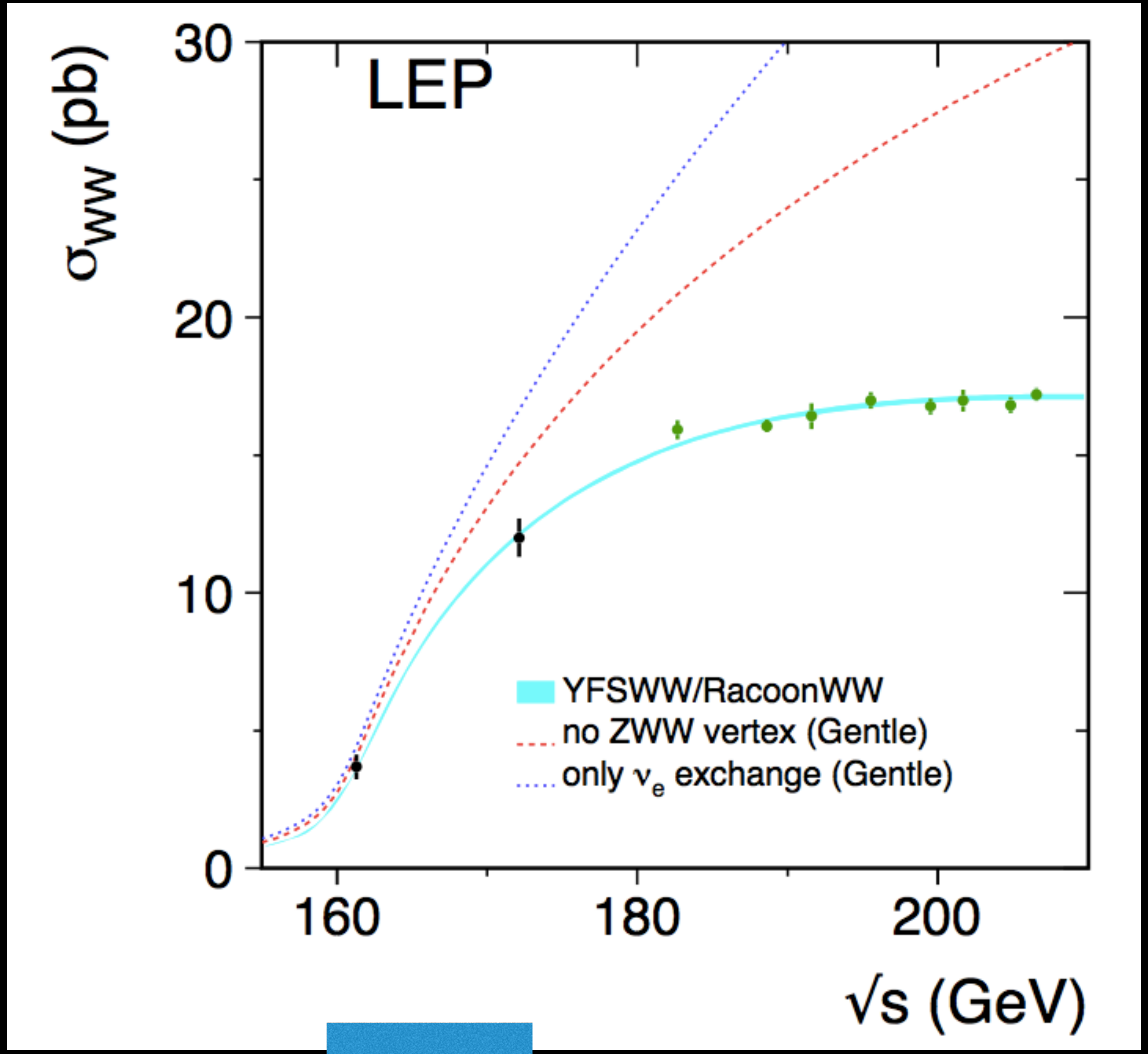
Complete Fit

m_H (minimum)= 125.2 GeV, Range m_H = [116, 133], m_H < 153.9 GeV @ 95%

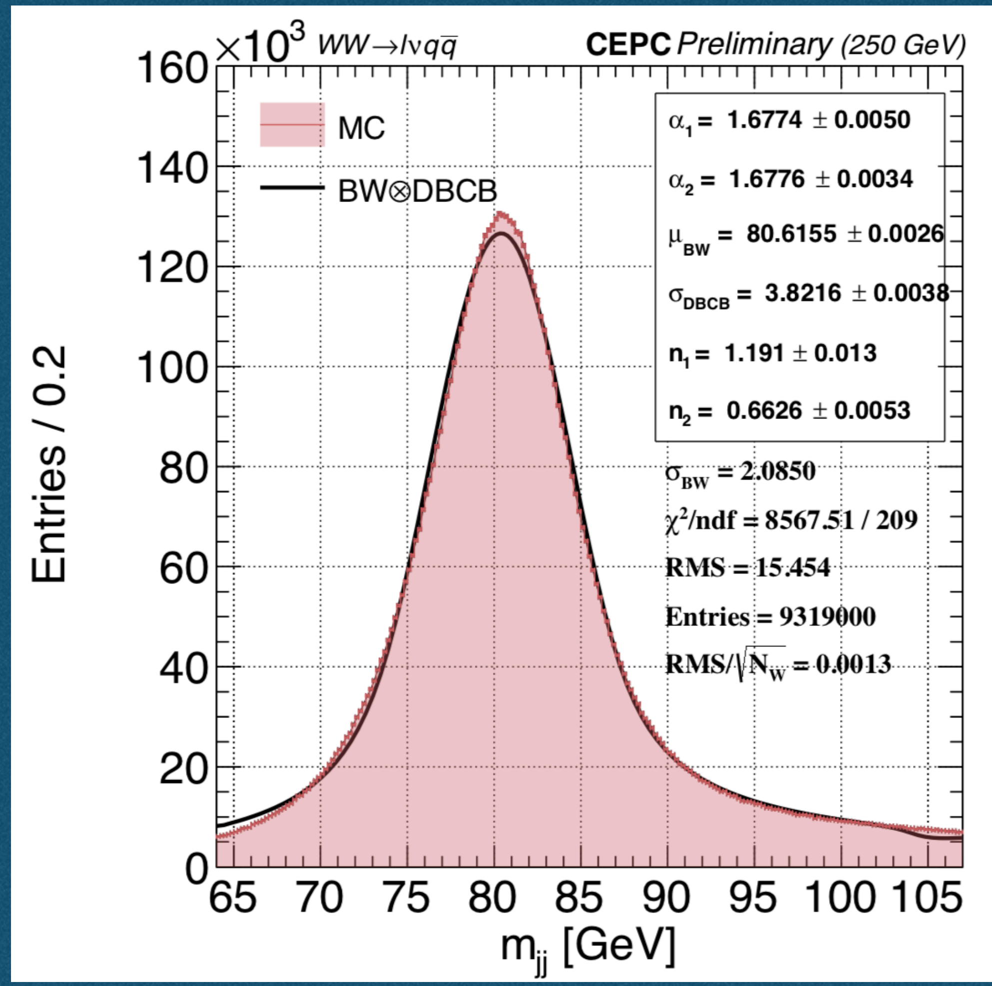
Thanks to Matthias Schott from the GFitter group

W mass measurement

2 methods to extract W mass



Direct measurement √s = 240 GeV
WW → lvqq , WW → qqqq

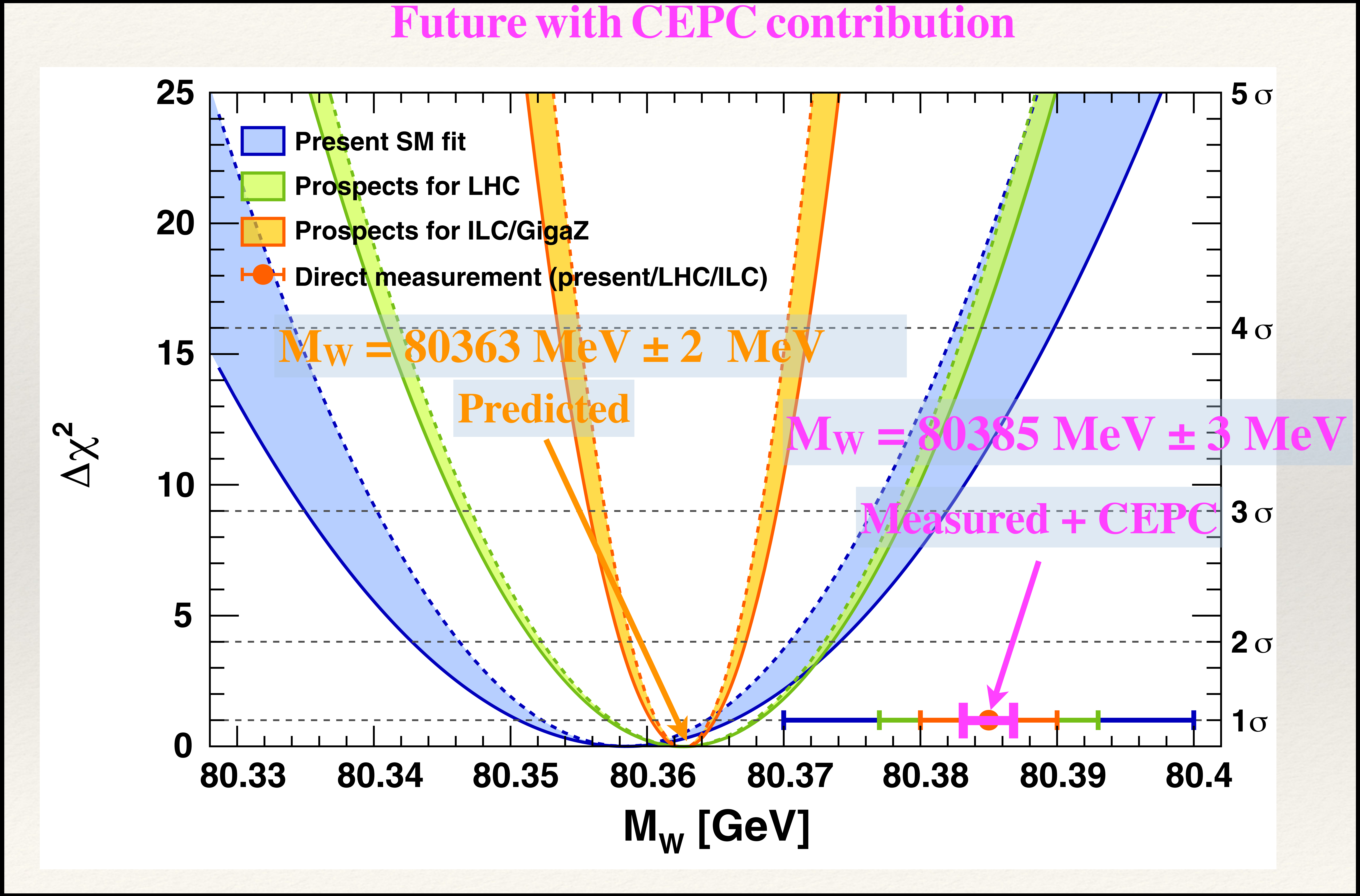


ΔM_W = 2-3 MeV

Energy scan threshold
Limiting factor is beam energy uncertainty: ΔE ~ 0.5 MeV

ΔM_W = 1 MeV

The W mass measurement



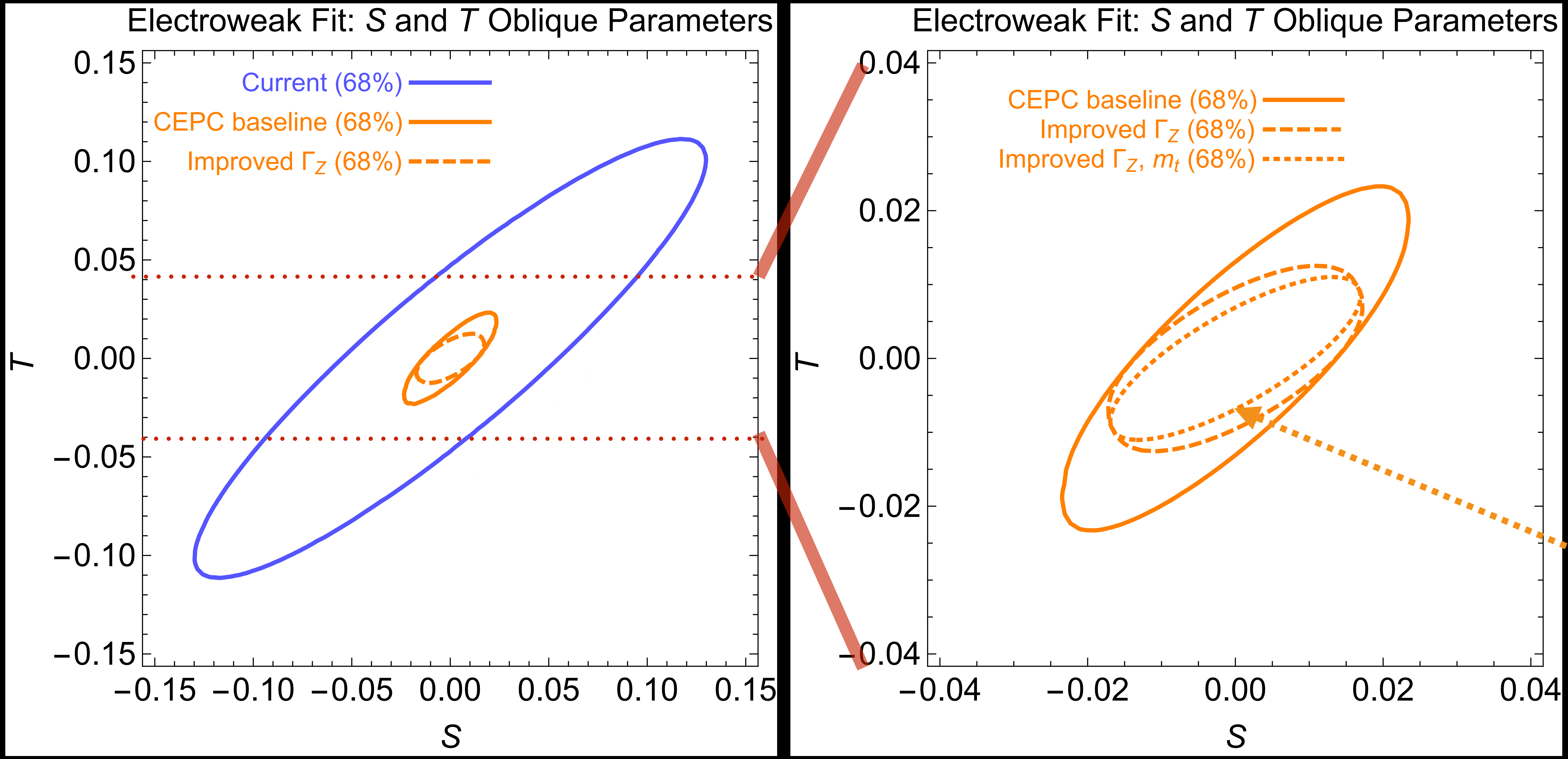
Electroweak observables at CEPC

Expect to have ~10^{11} Z boson for electroweak precision physics

Observable	LEP precision	CEPC precision	CEPC runs
m_Z	2 MeV	0.5 MeV	Z threshold scan
A^b_{FB}	1.7%	0.1%	Z threshold scan
$\sin^2\theta_W^{\rm eff}$	0.07%	0.002%	Z threshold scan
R_b	0.3%	0.02%	Z pole
R_μ	0.2%	0.01%	Z pole
N_ν	1.7%	0.05%	ZH runs
m_W	33 MeV	2-3 MeV	ZH runs
m_W	33 MeV	1 MeV	WW threshold

New physics from precision measurements

Probe New Physics scale up to O(10-100) TeV

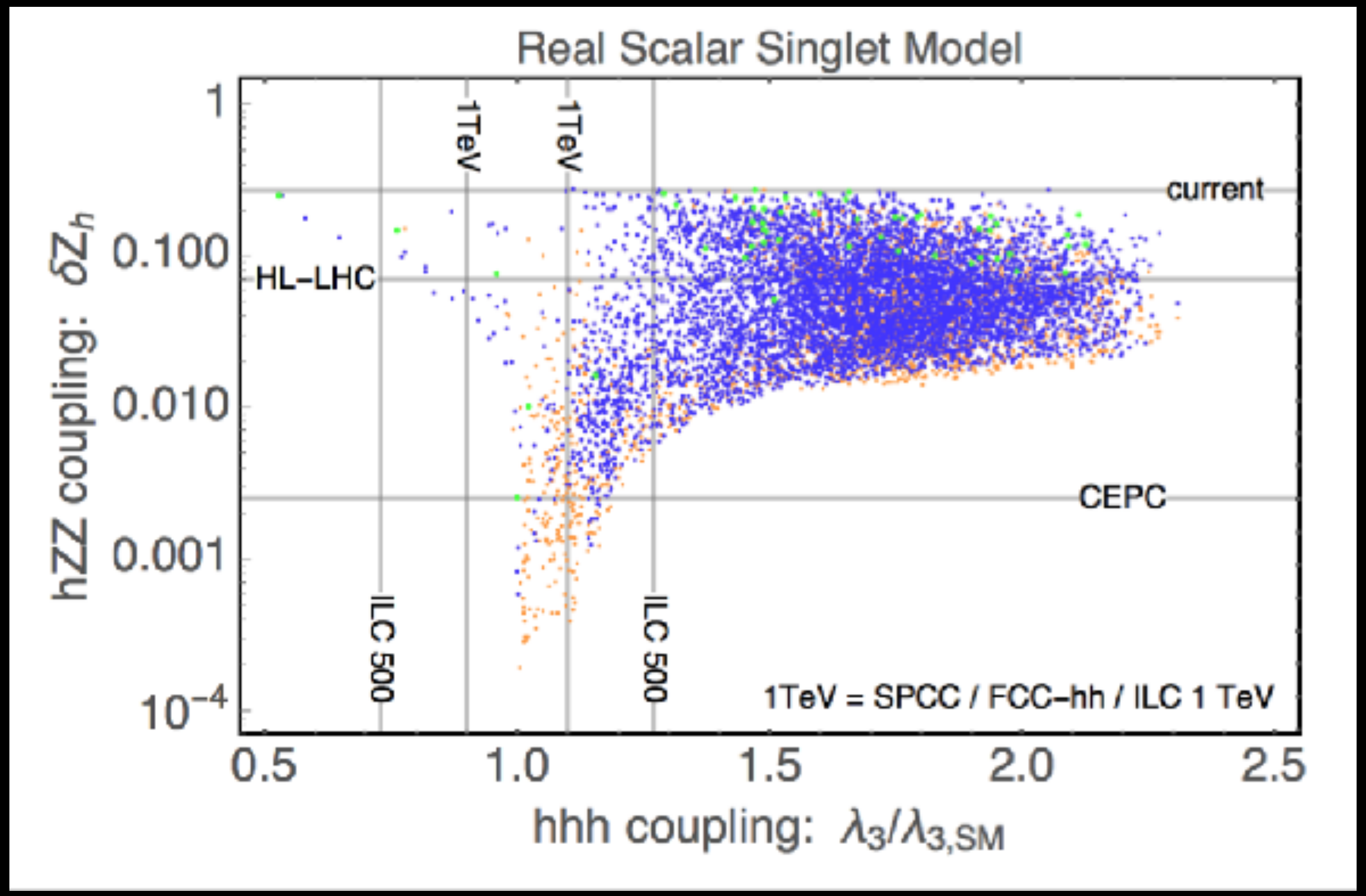


Improvement from top mass

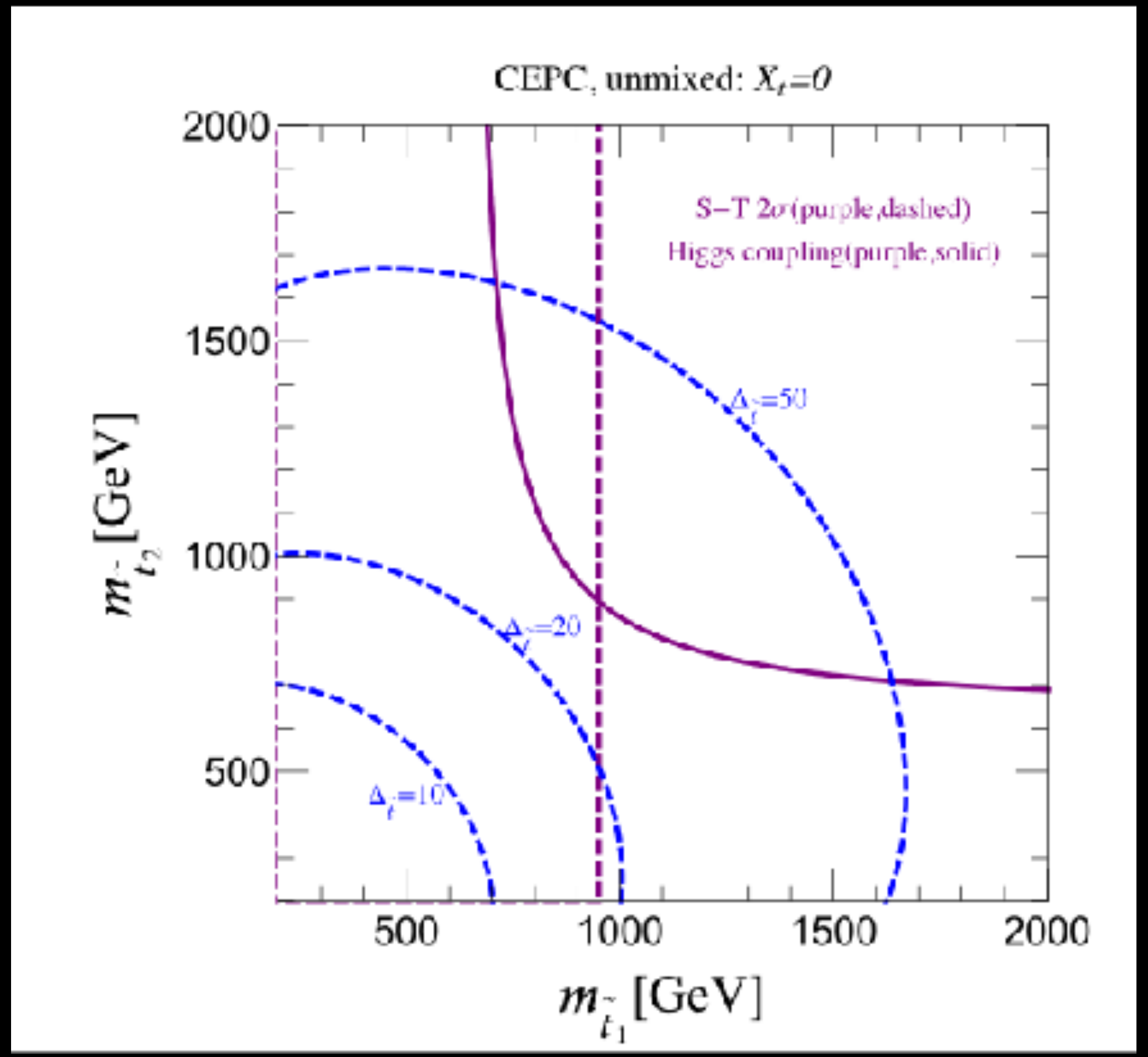
From PreCDR
arxiv:1411.1054

A few other physics highlights

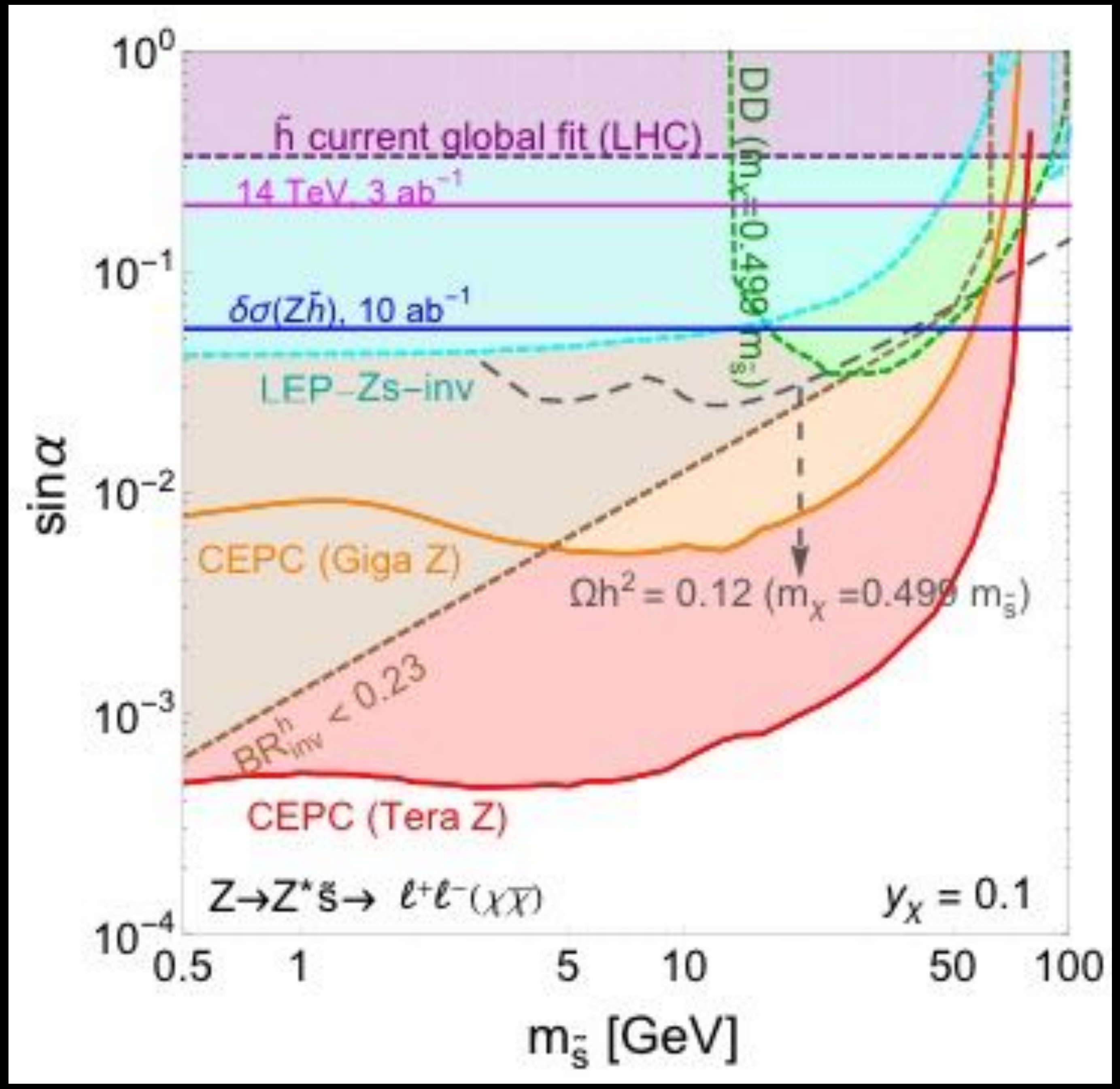
Is EWPT 1st order?



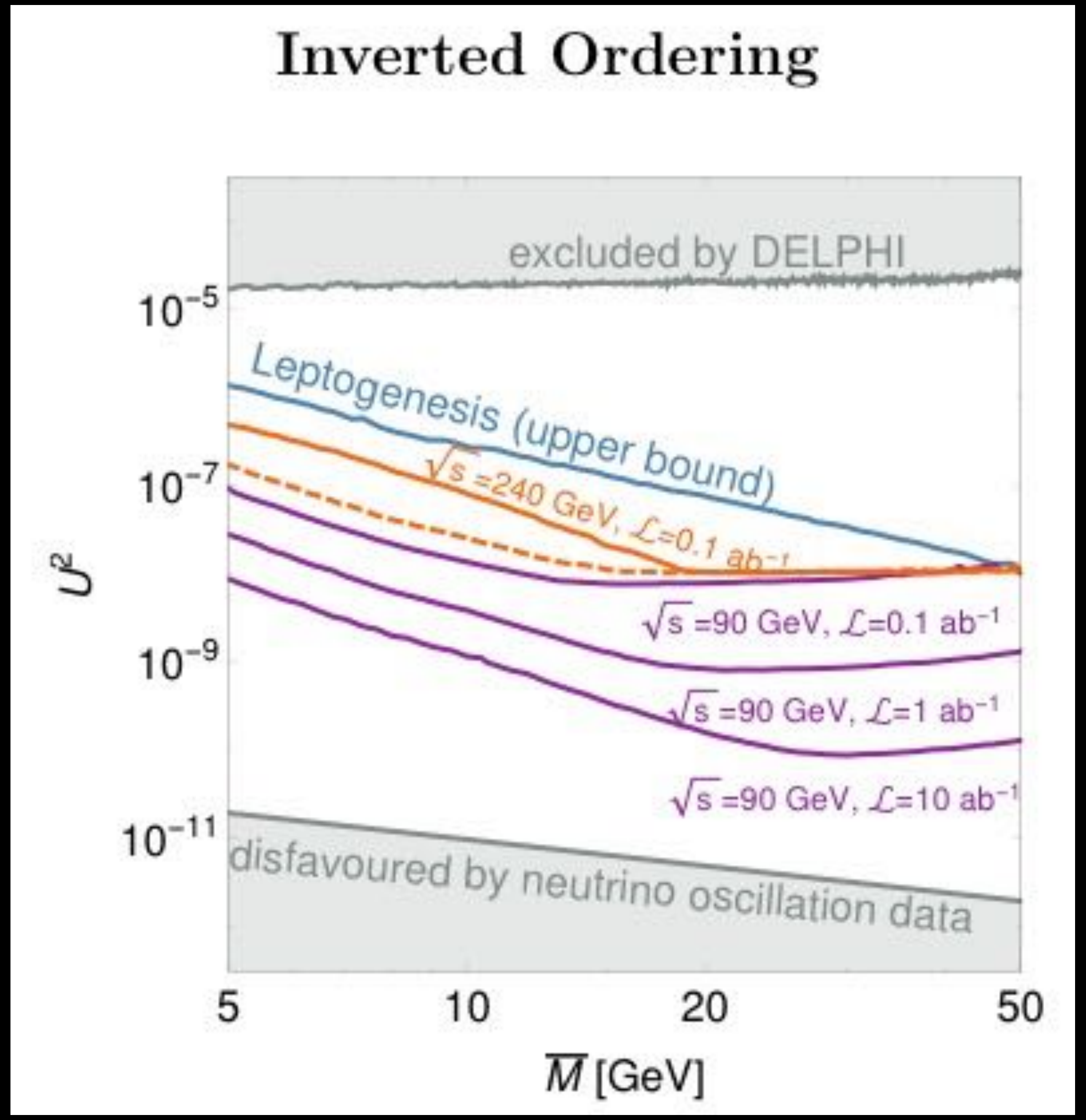
Naturalness



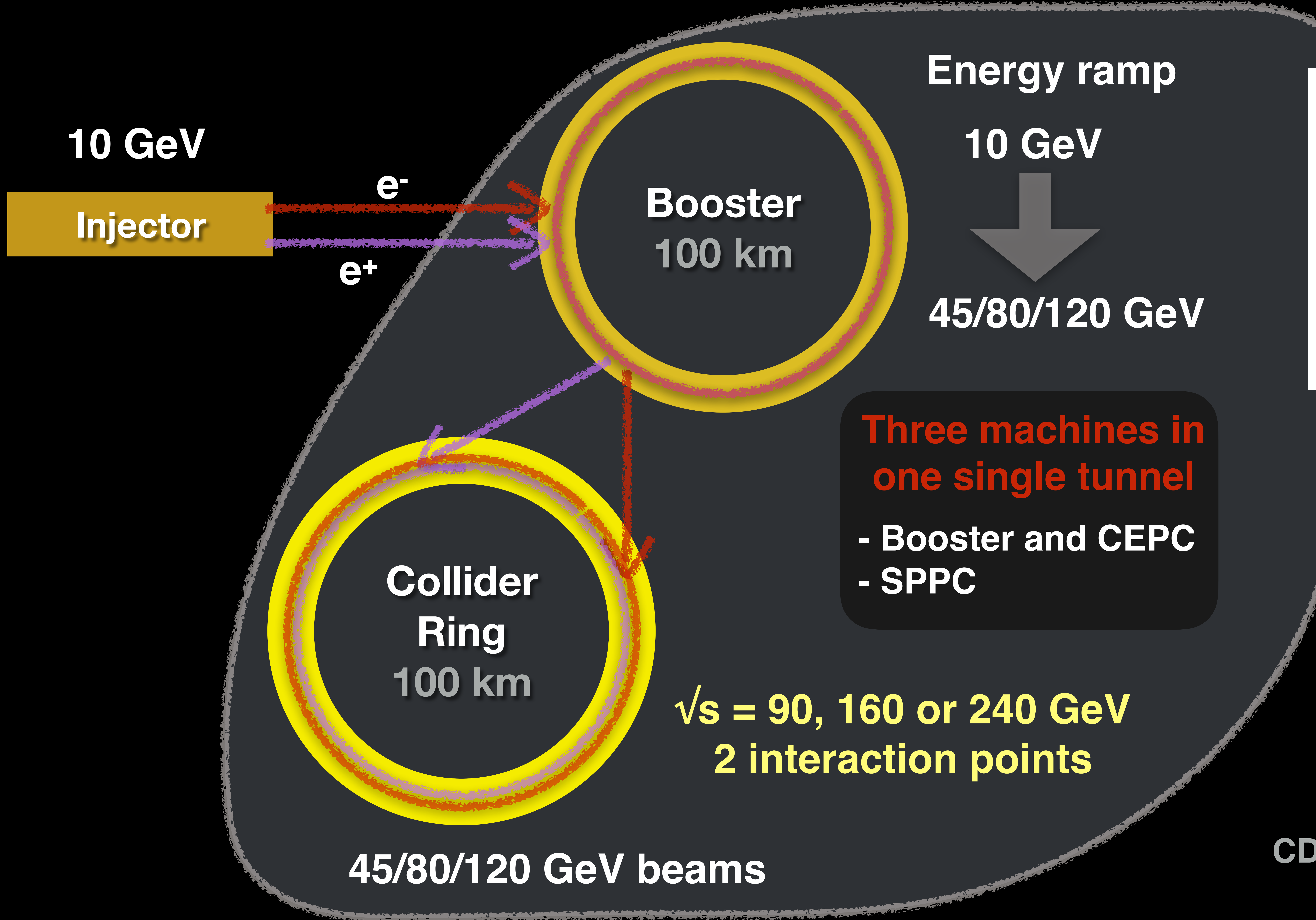
Dark sector search
With Z rare decay



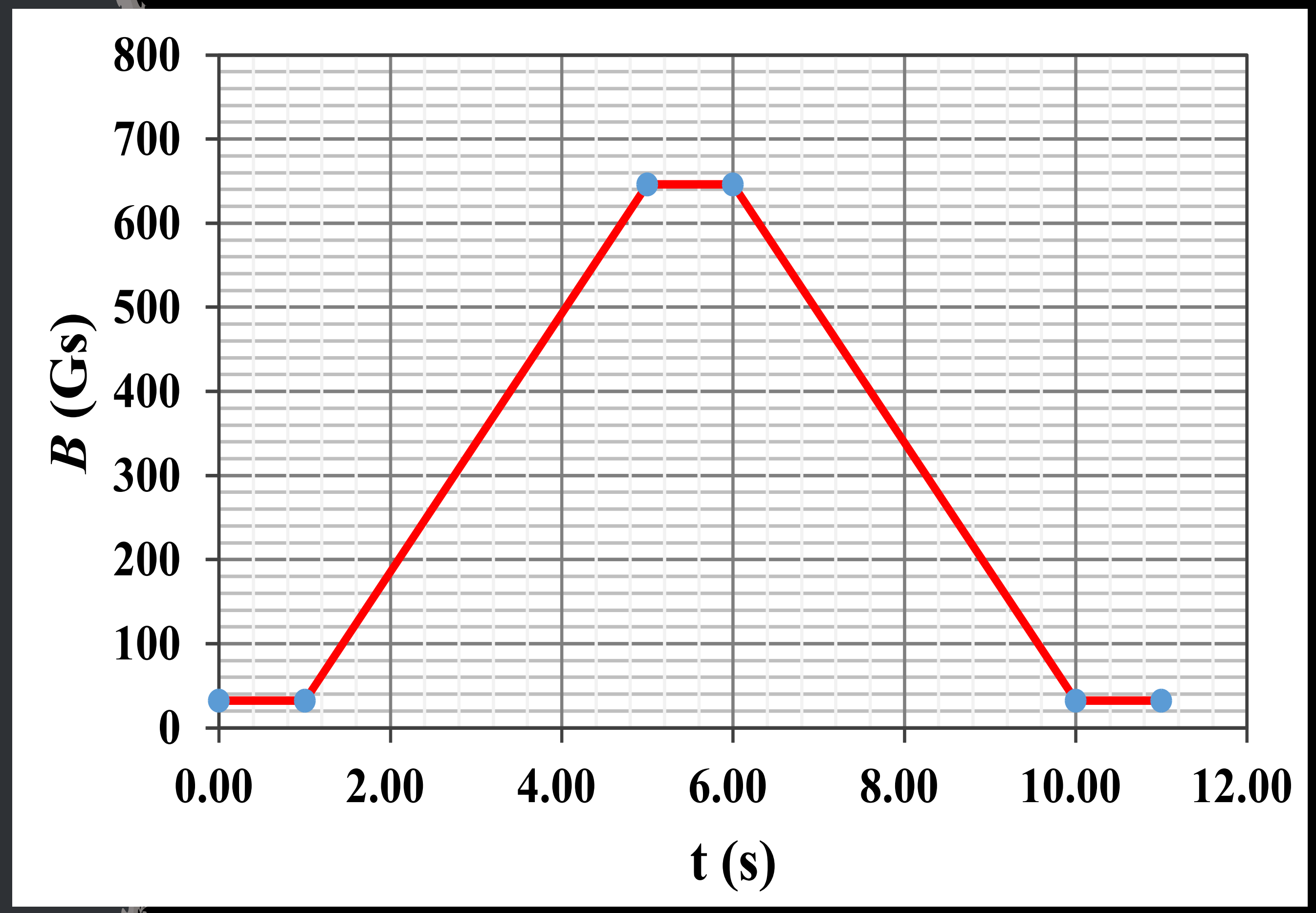
Origin of neutrino mass



CEPC Accelerator Chain and Systems



Booster Cycle (0.1 Hz)

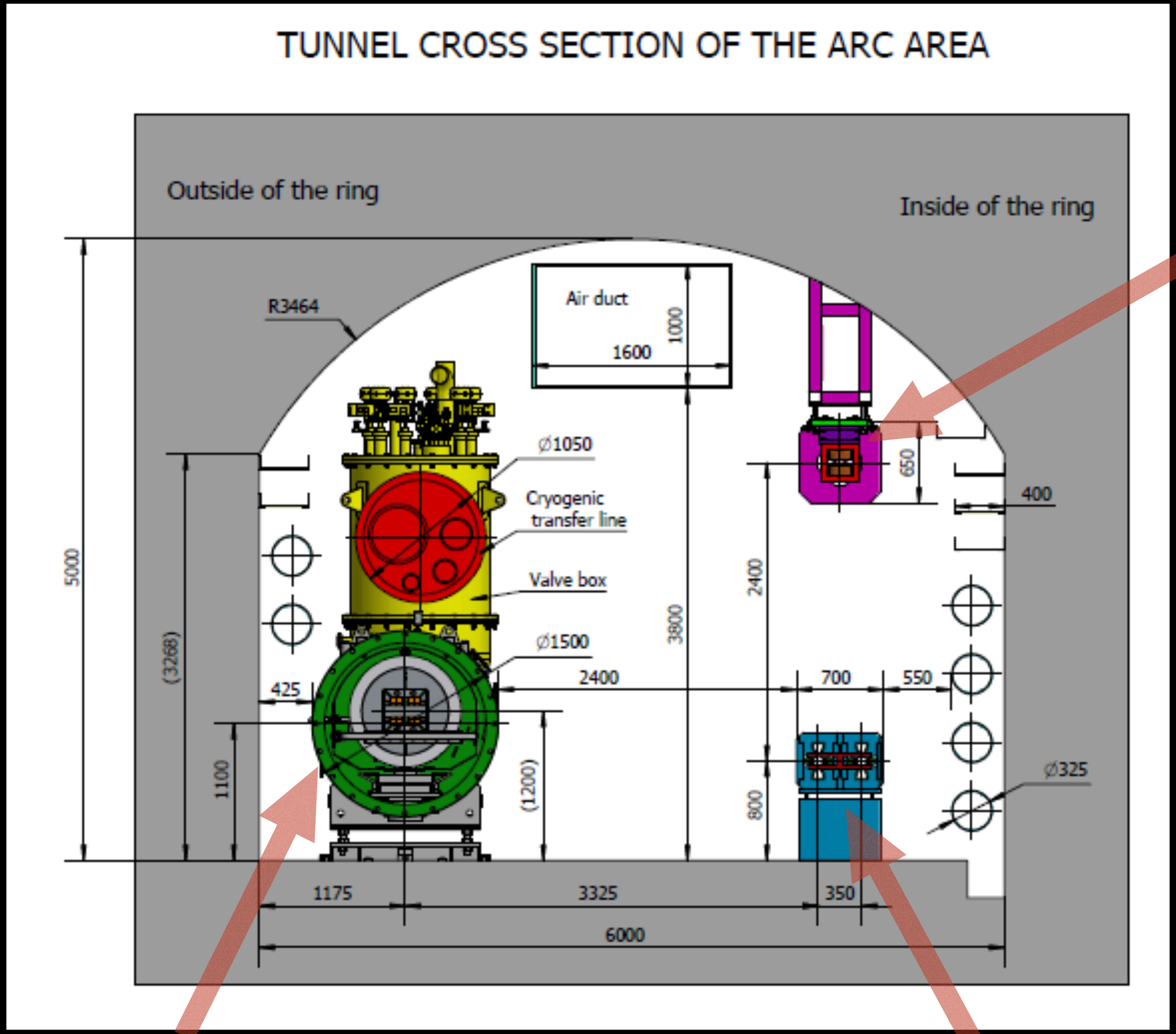


The key systems of CEPC:

1) Linac Injector
2) Booster
3) Collider ring
4) Machine Detector Interface
5) Civil Engineering

CDR provides details of all systems

The 100k tunnel cross section

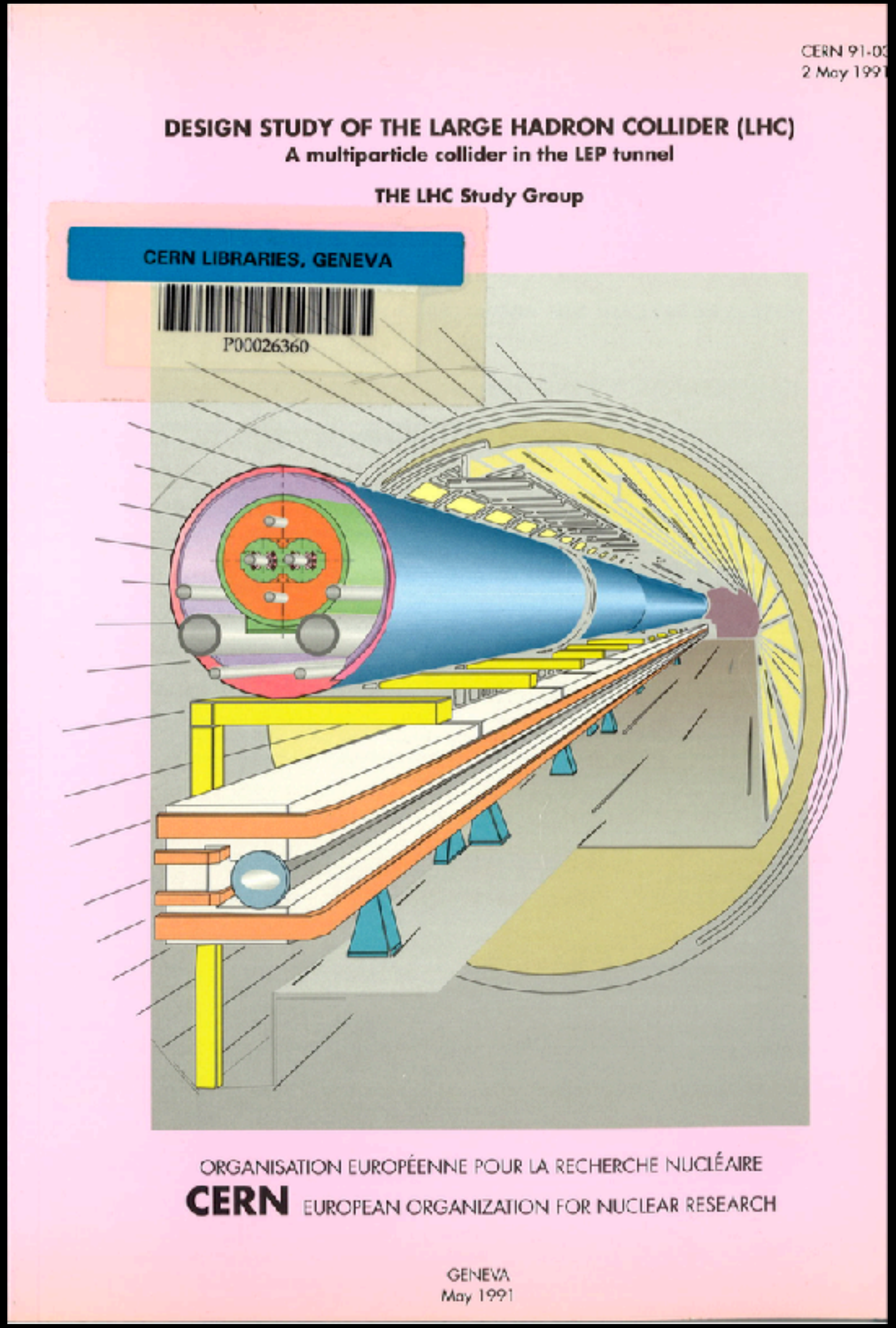


CEPC Booster

SPPC collider

CEPC collider

Proposed in Lausanne Workshop in 1984

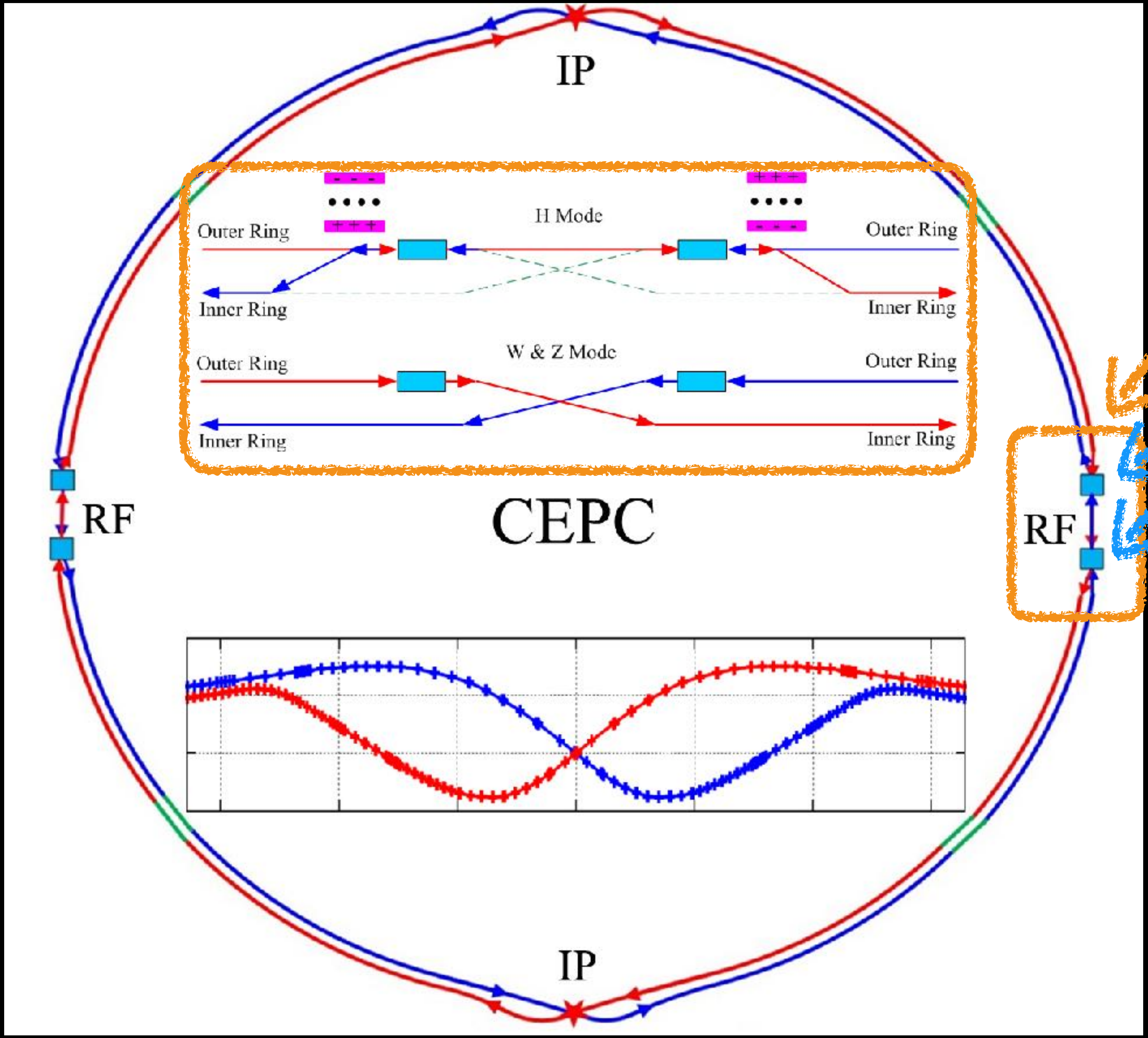


CEPC Civil Engineering Design very advanced

LEP tunnel internal diameter is 3.8 metres in the arcs

4.4 or 5.5 metres in the straight sections

The CEPC Baseline Collider Design



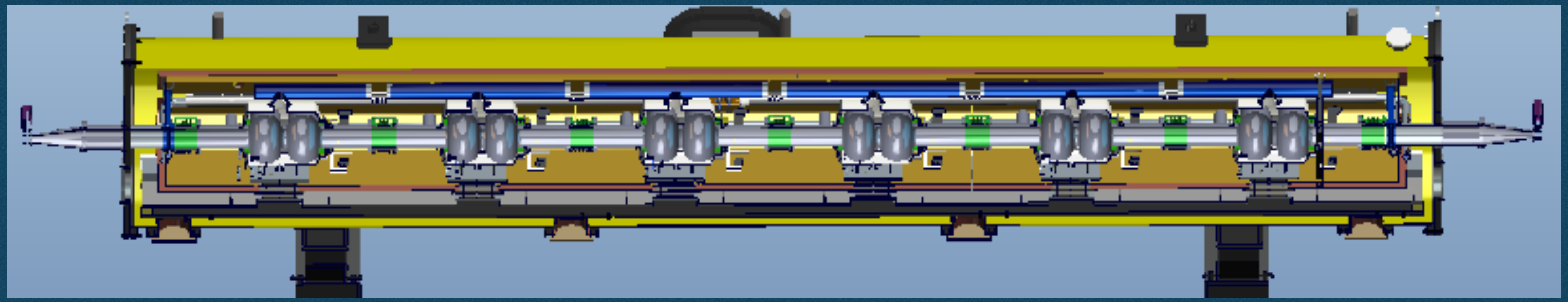
Double ring

Common RF cavities for Higgs

Two RF sections in total

Two RF stations per RF section

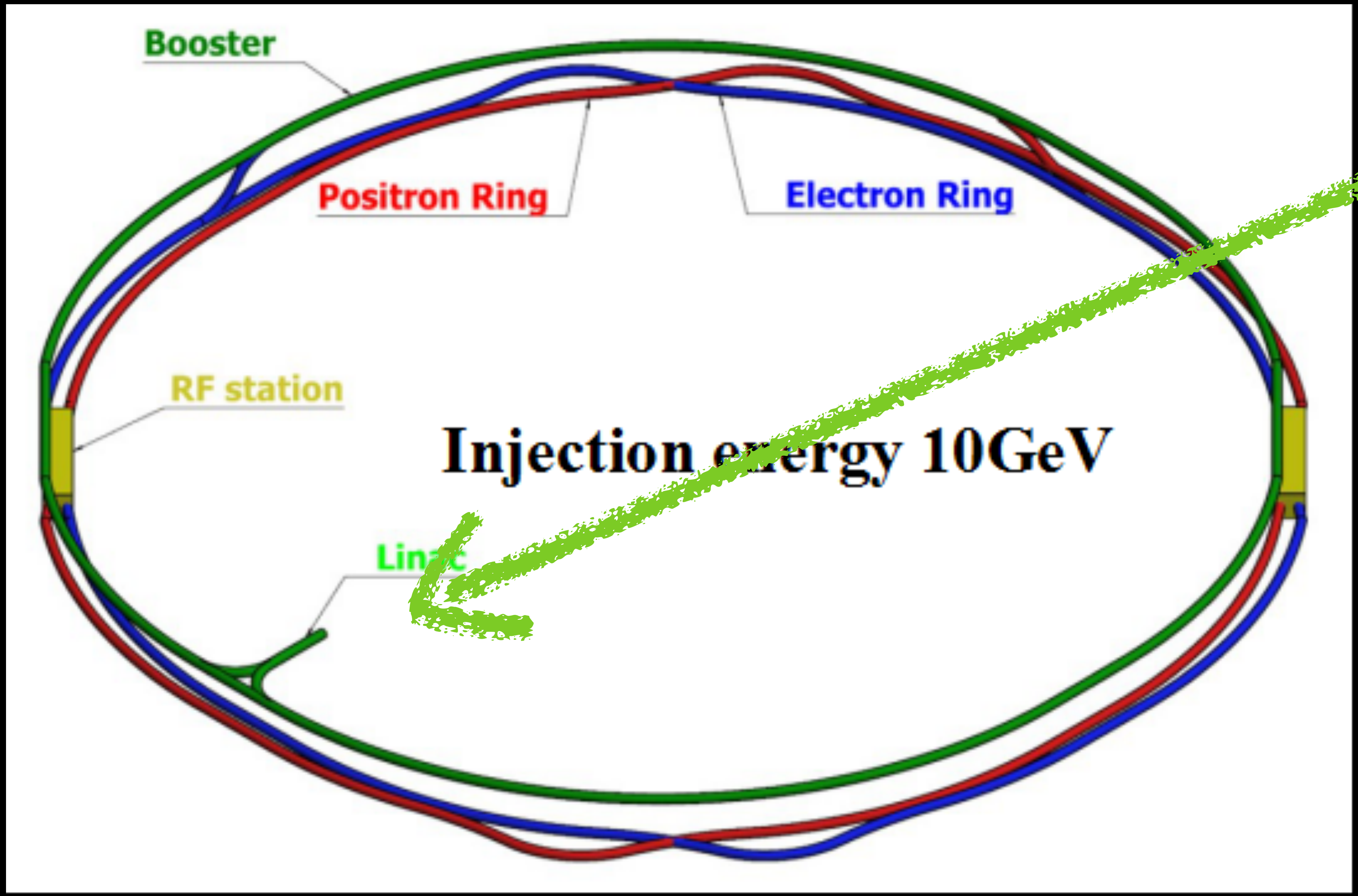
10 x 2 = 20 cryomodules



6 2-cell cavities per cryomodule

The CEPC Baseline Collider Design — Injection

Positron target



e+/e- beam energy:
10 GeV

Total beam transfer efficiency: 90%

45 GeV Plasma Wakefield Accelerator considered as an alternative

Main Parameters of Collider Ring

	Higgs	W	Z (3T)	Z (2T)
Number of IPs	2			
Beam energy (GeV)	120	80	45.5	
Circumference (km)	100			
Synchrotron radiation loss/turn (GeV)	1.73	0.34	0.036	
Crossing angle at IP (mrad)	16.5×2			
Piwinski angle	2.58	7.0	23.8	
Number of particles/bunch N_e (10^{10})	15.0	12.0	8.0	
Bunch number (bunch spacing)	242 (0.68μs)	1524 (0.21μs)	12000 (25ns+10%gap)	
Beam current (mA)	17.4	87.9	461.0	
Synchrotron radiation power /beam (MW)	30	30	16.5	
β function at IP β_x^* / β_y^* (m)	0.36/0.0015	0.36/0.0015	0.2/0.0015	0.2/0.001
Emittance $\varepsilon_x/\varepsilon_y$ (nm)	1.21/0.0031	0.54/0.0016	0.18/0.004	0.18/0.0016
Beam size at IP σ_x/σ_y (μm)	20.9/0.068	13.9/0.049	6.0/0.078	6.0/0.04
RF frequency f_{RF} (MHz) (harmonic)	650 (216816)			
Bunch length σ_z (mm)	3.26	5.9	8.5	
Natural energy spread (%)	0.1	0.066	0.038	
Photon number due to beamstrahlung	0.29	0.35	0.55	
Lifetime (hour)	0.67	1.4	4.0	2.1
Luminosity/IP L (10^{34} $cm^{-2}s^{-1}$)	2.93	10.1	16.6	32.1

Accelerator key technologies R&D

The key accelerator technologies are under studying with dedicated funds

- **Polarized electron gun**
  - ⇨ Super-lalce GaAs photocathode DC-Gun
- **High current positron source**
  - ⇨ bunch charge of ~3nC,
  - ⇨ 6Tesla Flux Concentrator peak magnetic field
- **SCRF system**
  - ⇨ High Q cavity - Max operation $Q_0 = 2\times10^{10}$ @ 2 K
  - ⇨ High power coupler - 300kW (Variable)
- **High efficiency CW klystron**
  - ⇨ Efficiency goal > 80%
- **Low field dipole magnet (booster)**
  - ⇨ $L_{mag} = 5$ m, $B_{min} = 30$ Gs, Errors $<5\times10^{-4}$
- **Vacuum system**
  - ⇨ 6m long cooper chamber
  - ⇨ RF shielding bellows
- **Electro-static separator**
  - ⇨ Maximum operating field strength: 20kV/cm
  - ⇨ Maximum deflection: 145 urad
- **Large scale cryogenics**
  - ⇨ 12 kW @4.5K refrigerator, Oversized,
  - ⇨ Custom-made, Site integration
- **HTS magnet**
  - ⇨ Advanced HTS Cable R&D: > 10kA
  - ⇨ Advanced High Field HTS Magnet R&D: main field 10~12T

Multiple prototypes have been constructed or are under design/construction

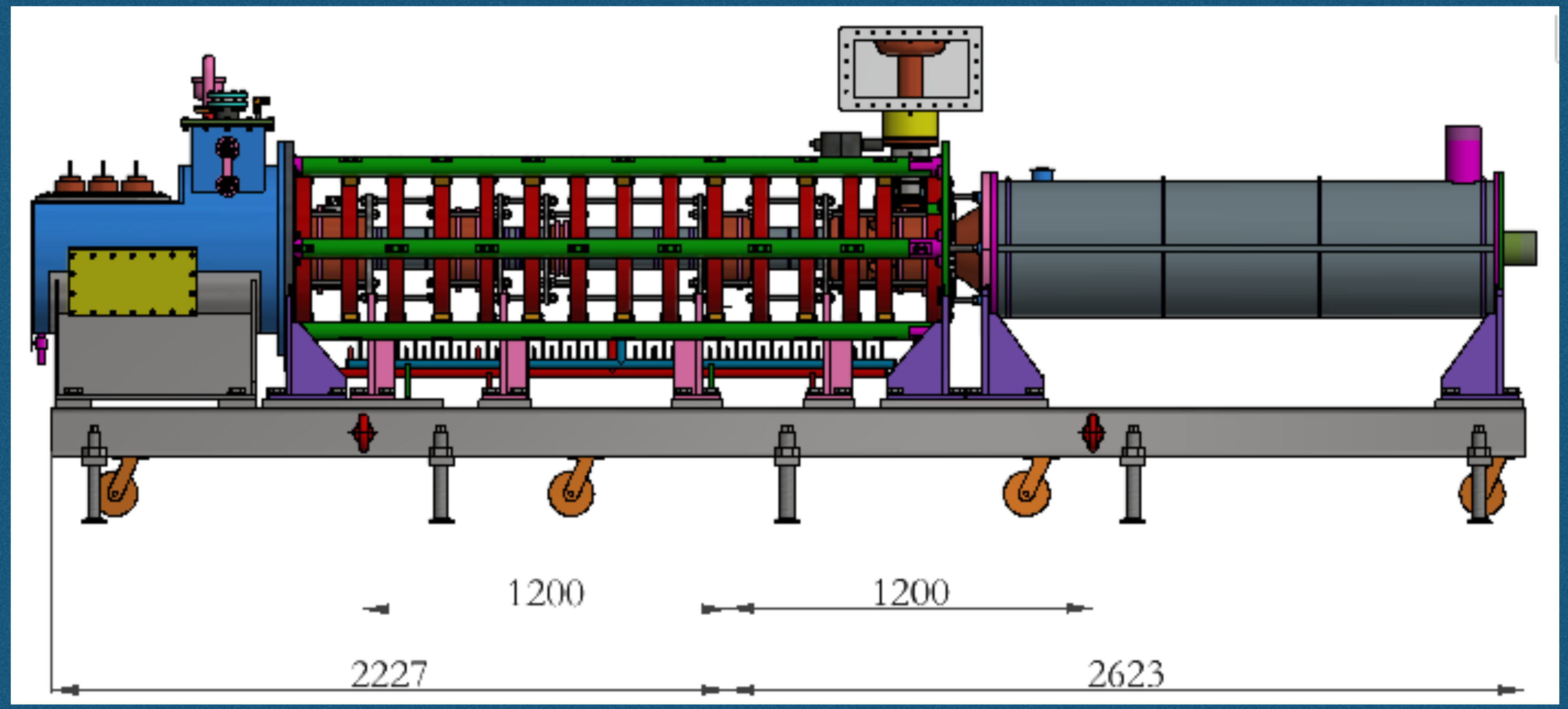
Accelerator key technologies R&D — prototypes

CEPC 650 MHz Cavity

Collaboration with Photon Source projects in Shanghai and Beijing (1.3 GHz cavities)

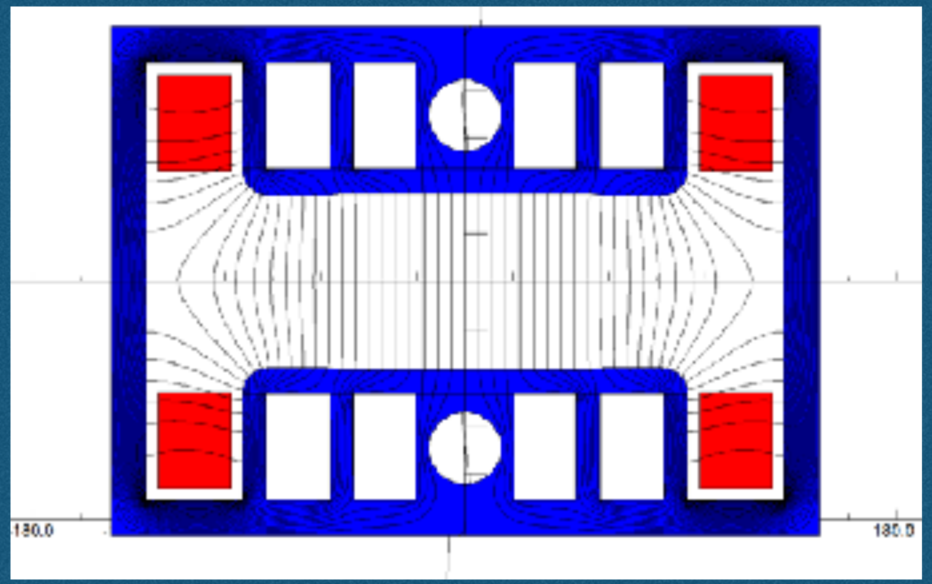
High Efficiency Klystron

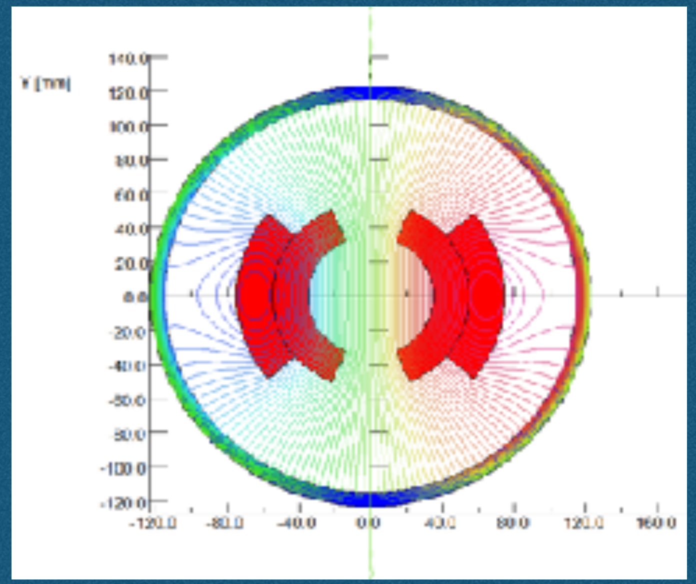
"High efficiency klystron collaboration consortium", including IHEP, Institute of Electronic) of CAS, and Kunshan Guoli Science and Tech.



3 high-efficiency klystron (up to 80%) prototypes to be built by 2021

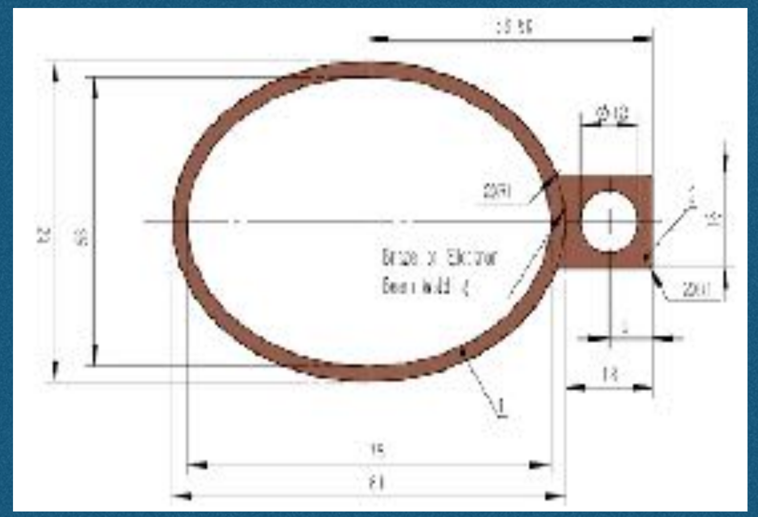
Booster low-field dipole magnets

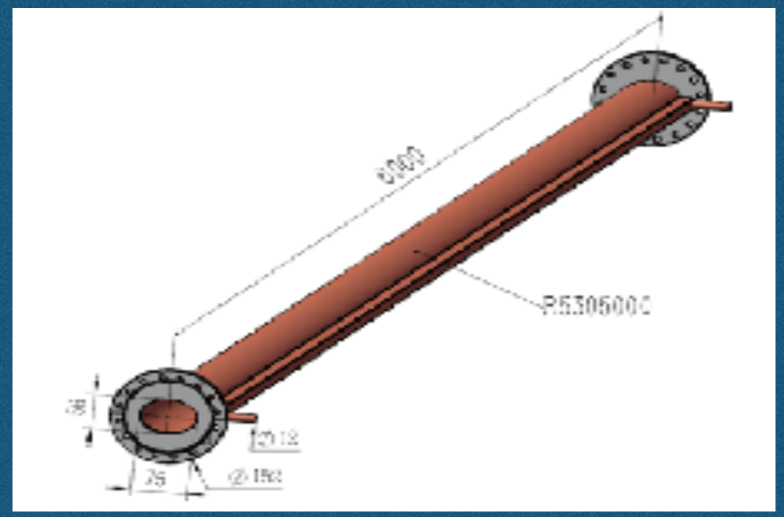


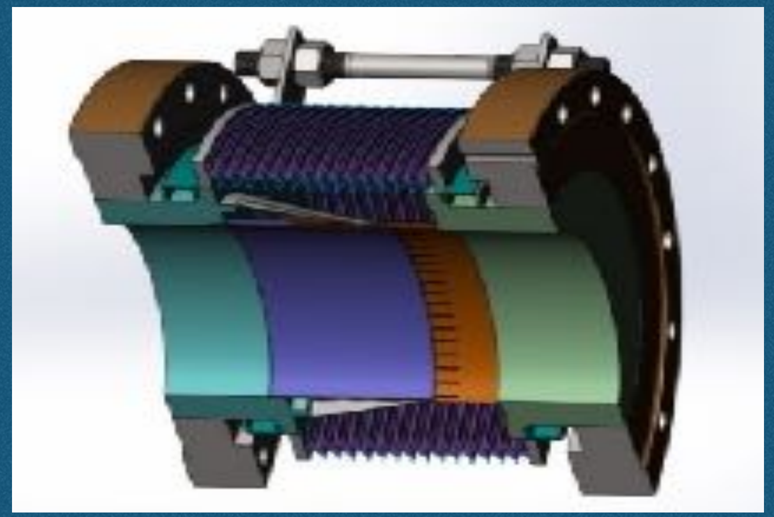


L_{mag} = 5 m, B_{min} = 30 Gs, Errors <5×10^{-4}

Vacuum system R&D



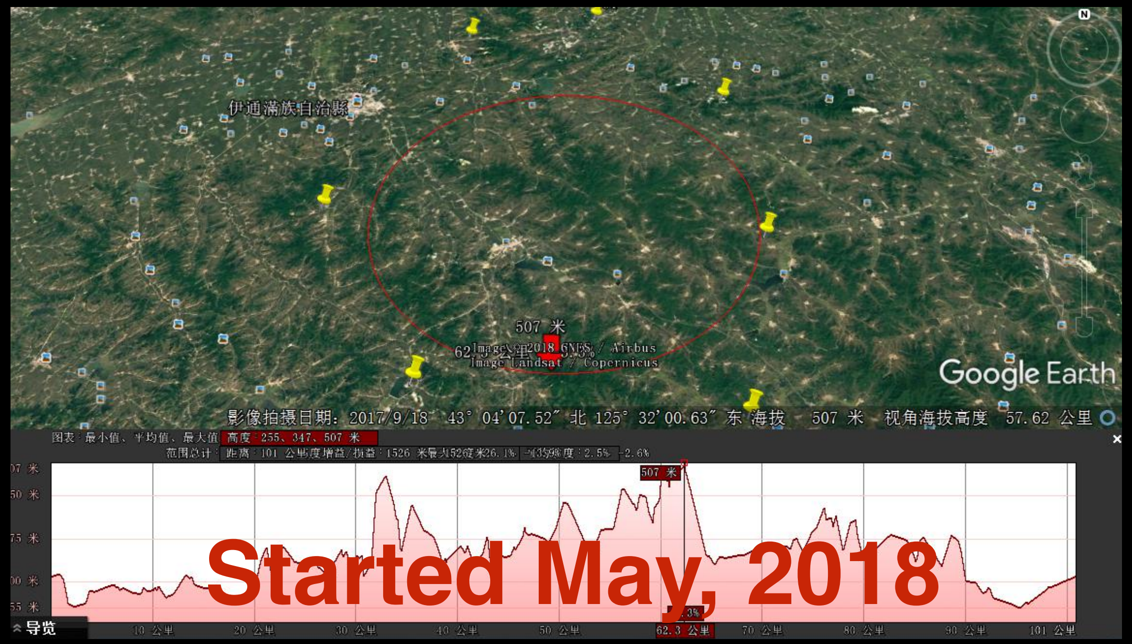




- 6m copper vacuum chamber: pressure 2×10^{-10} torr
- Bellows module: allow thermal expansion, alignment

Site selection

Chuangchun, Jilin
吉林长春

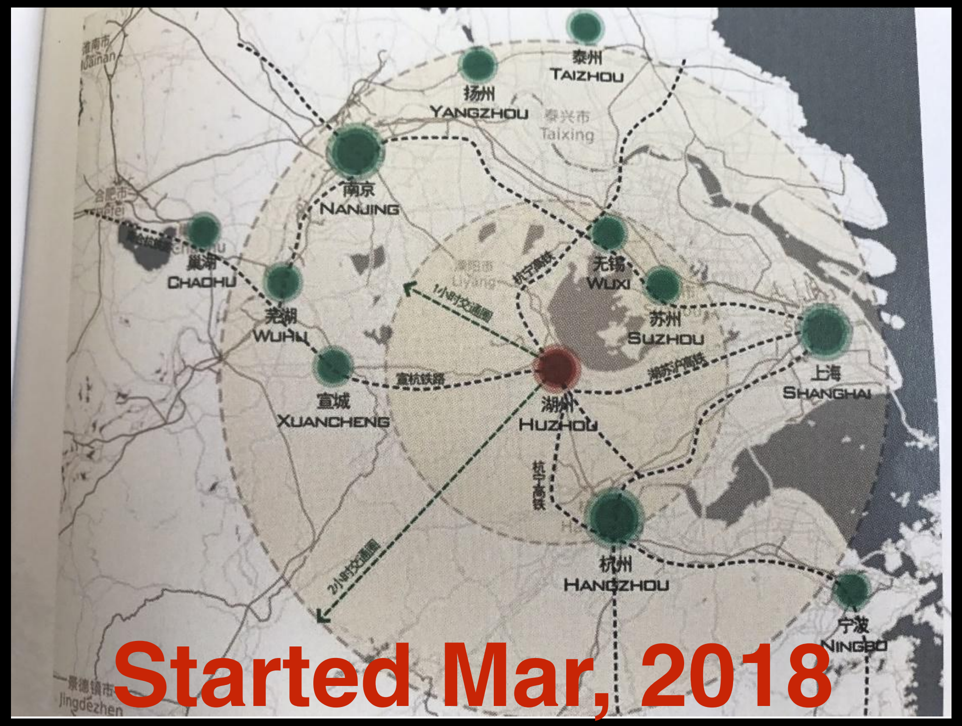


Huangling, Shanxi
陕西黄陵

Qinhuangdao, Hebei
河北秦皇岛

Xiong an, Hebei
河北雄安

Huzhou, Zhejiang
浙江湖州

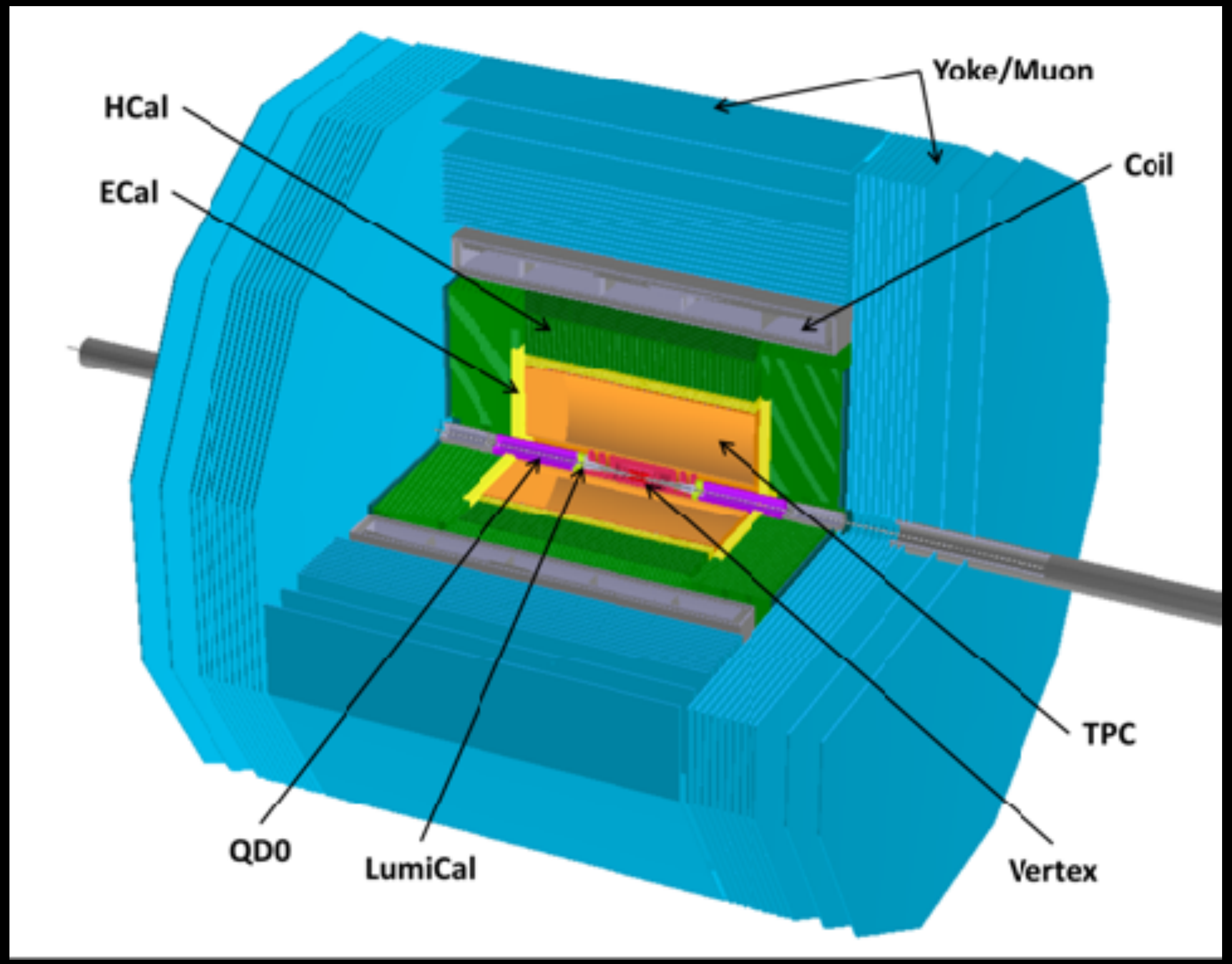


Shenshan, Guangdong
深汕合作区

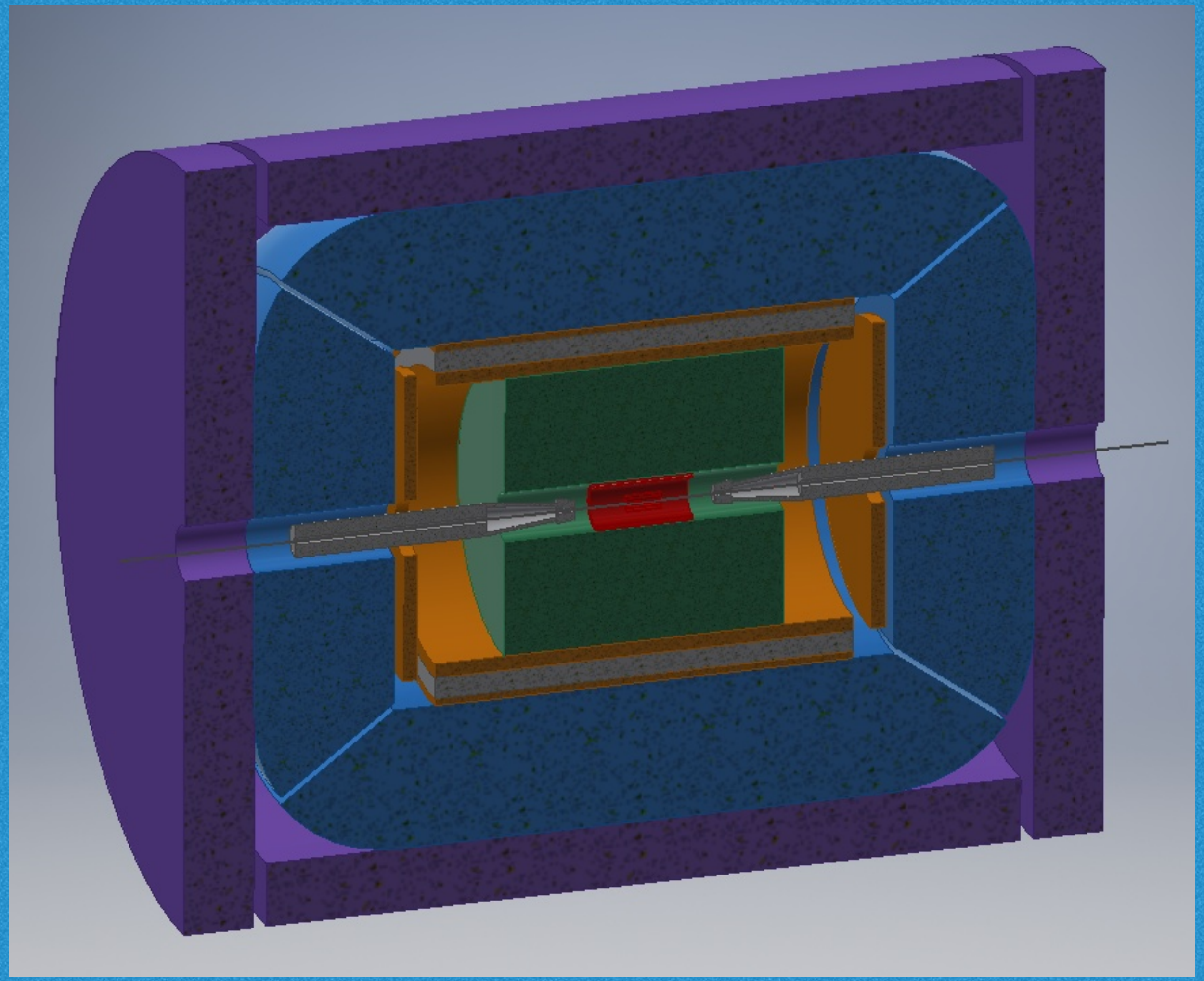
Considerations:
1. Available land
2. Geological conditions
3. Good social, environment, transportation and cultural conditions
4. Fit local development plan: mid-size city → + science city

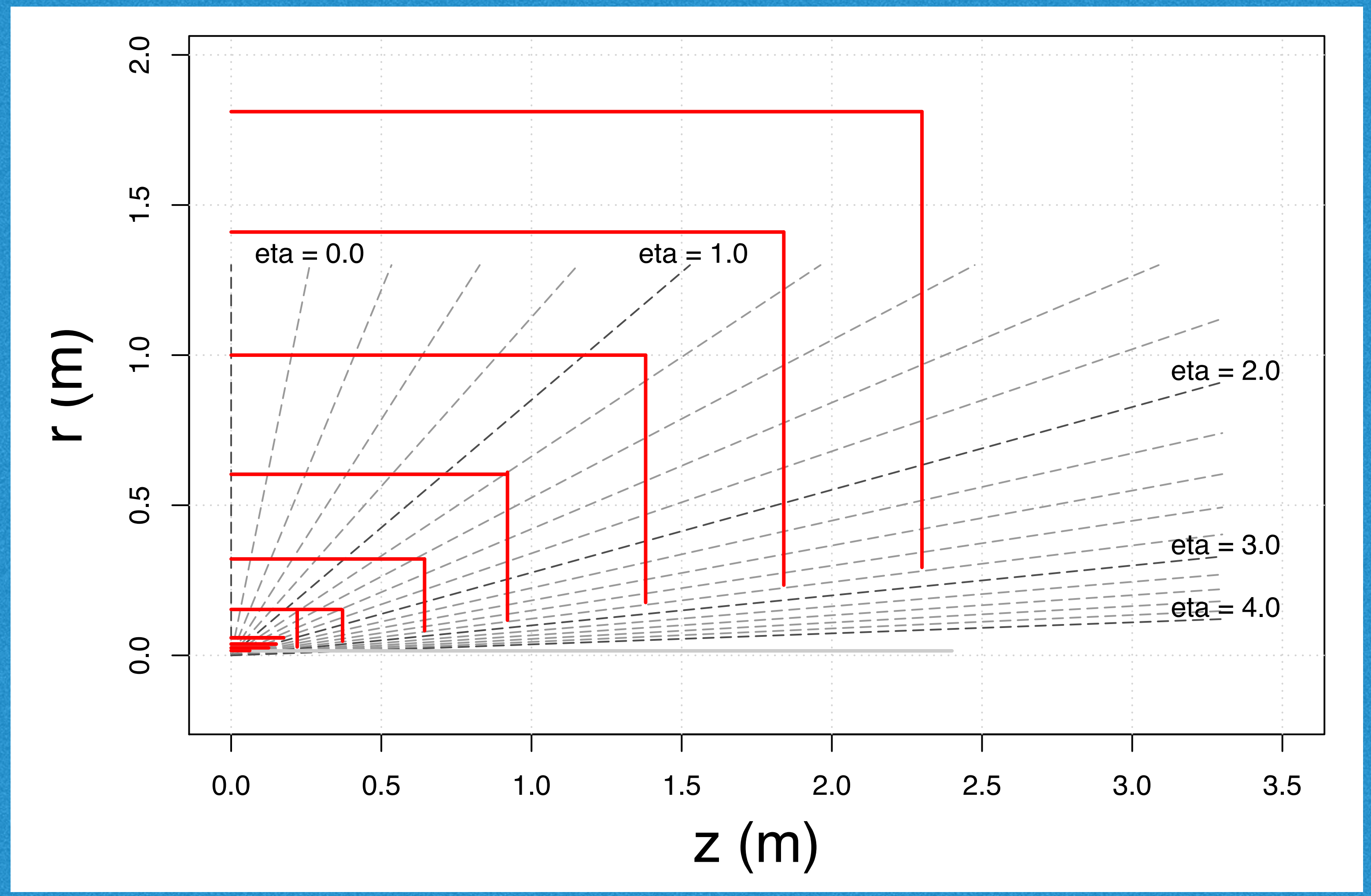
Detector Conceptual Designs (CDR)

Baseline detector (3 Tesla)
ILD-like
(similar to pre-CDR)



Low magnetic field concept (2 Tesla)

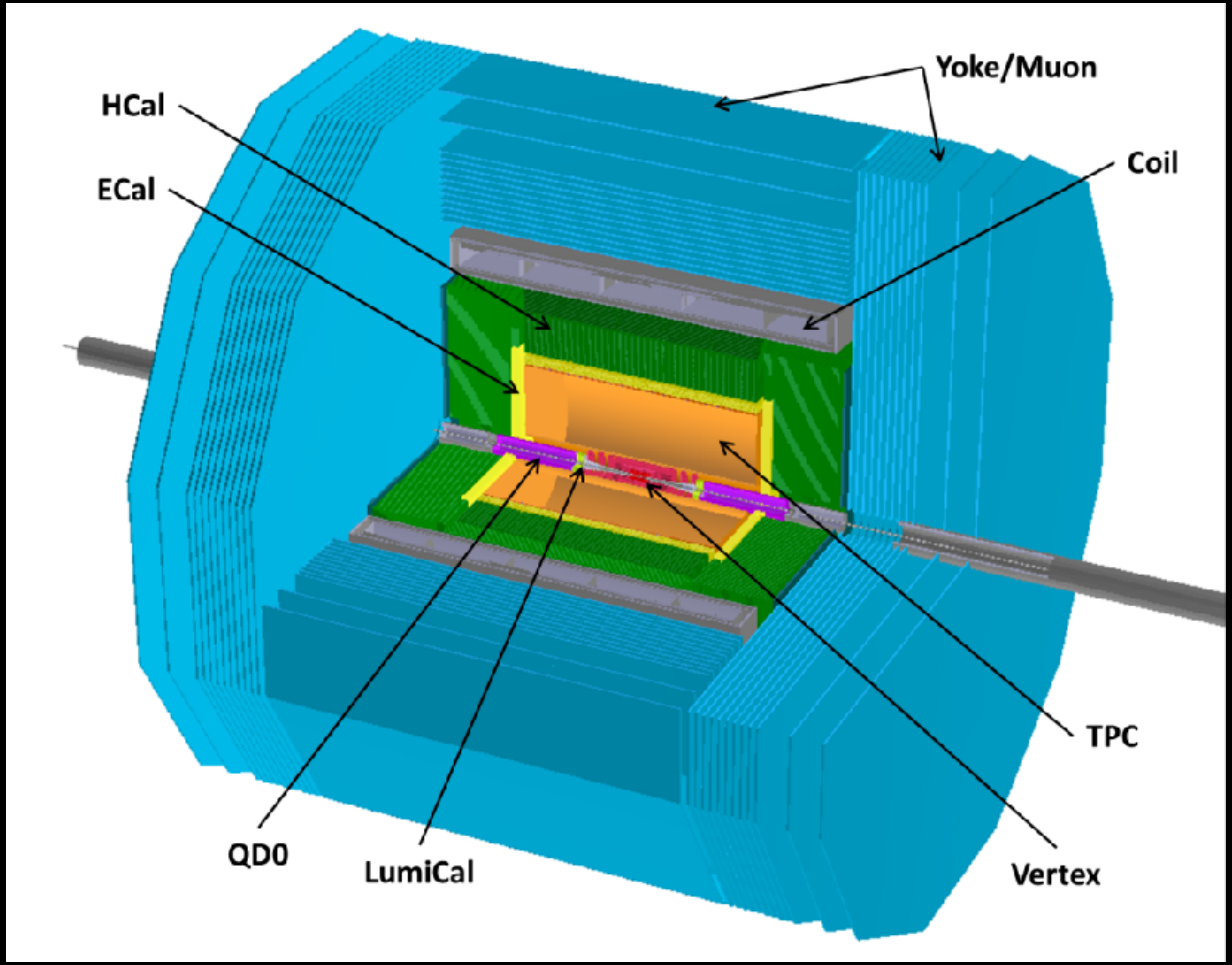


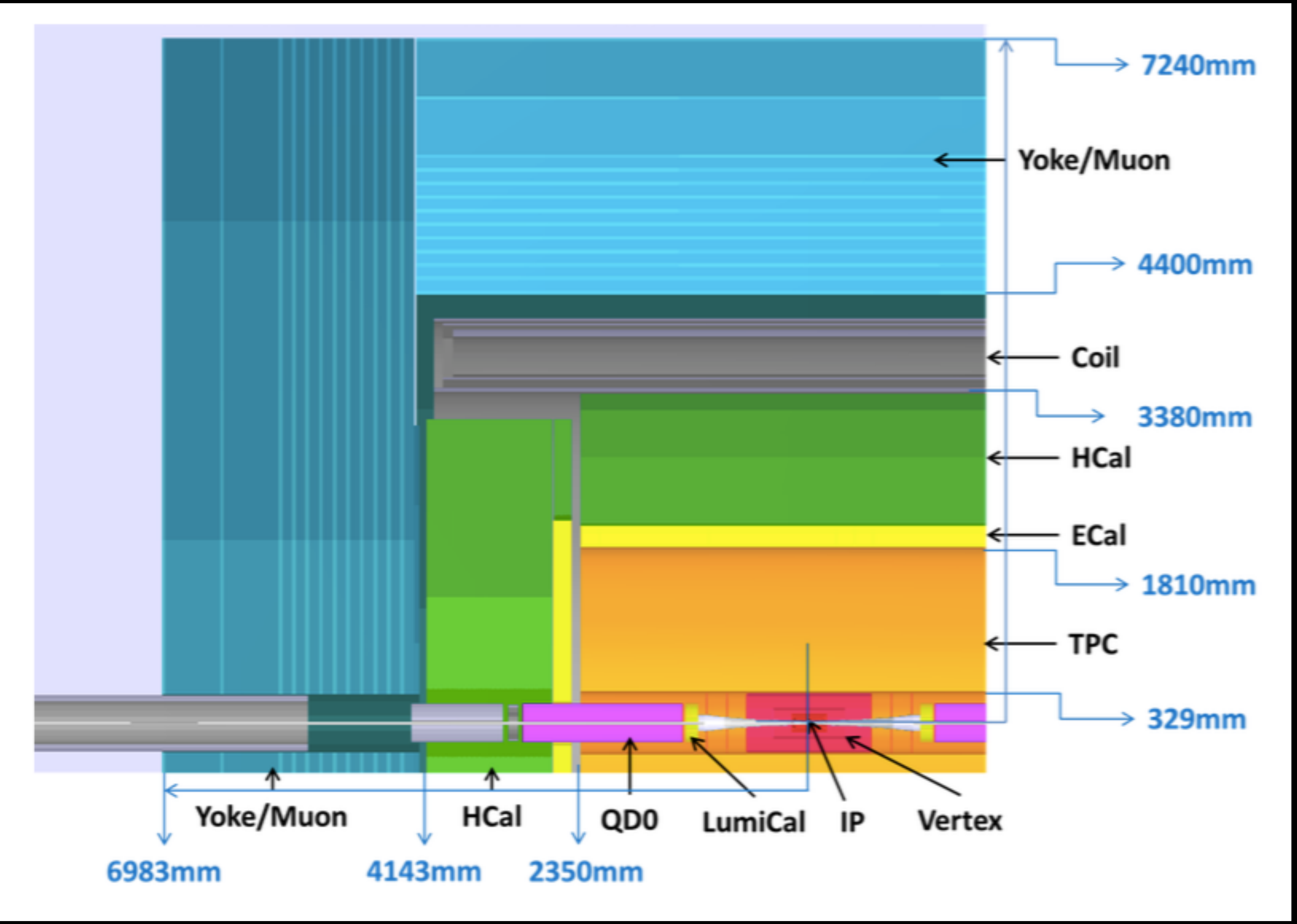


Full silicon tracker concept

Final two detectors likely to be a mix and match of different options

CEPC baseline detector: ILD-like





Magnetic Field: 3 Tesla — changed from preCDR

- **Impact parameter resolution**: less than 5 μm ⟵ Flavor tagging
- **Tracking resolution**: $\delta(1/P_t) \sim 2\times10^{-5}\ (\mathrm{GeV}^{-1})$ ⟵ BR(Higgs → μμ)
- **Jet energy resolution**: $\sigma_E/E \sim 30\%/\sqrt{E}$ ⟵ W/Z dijet mass separation

CEPC baseline detector: ILD-like: Design Considerations

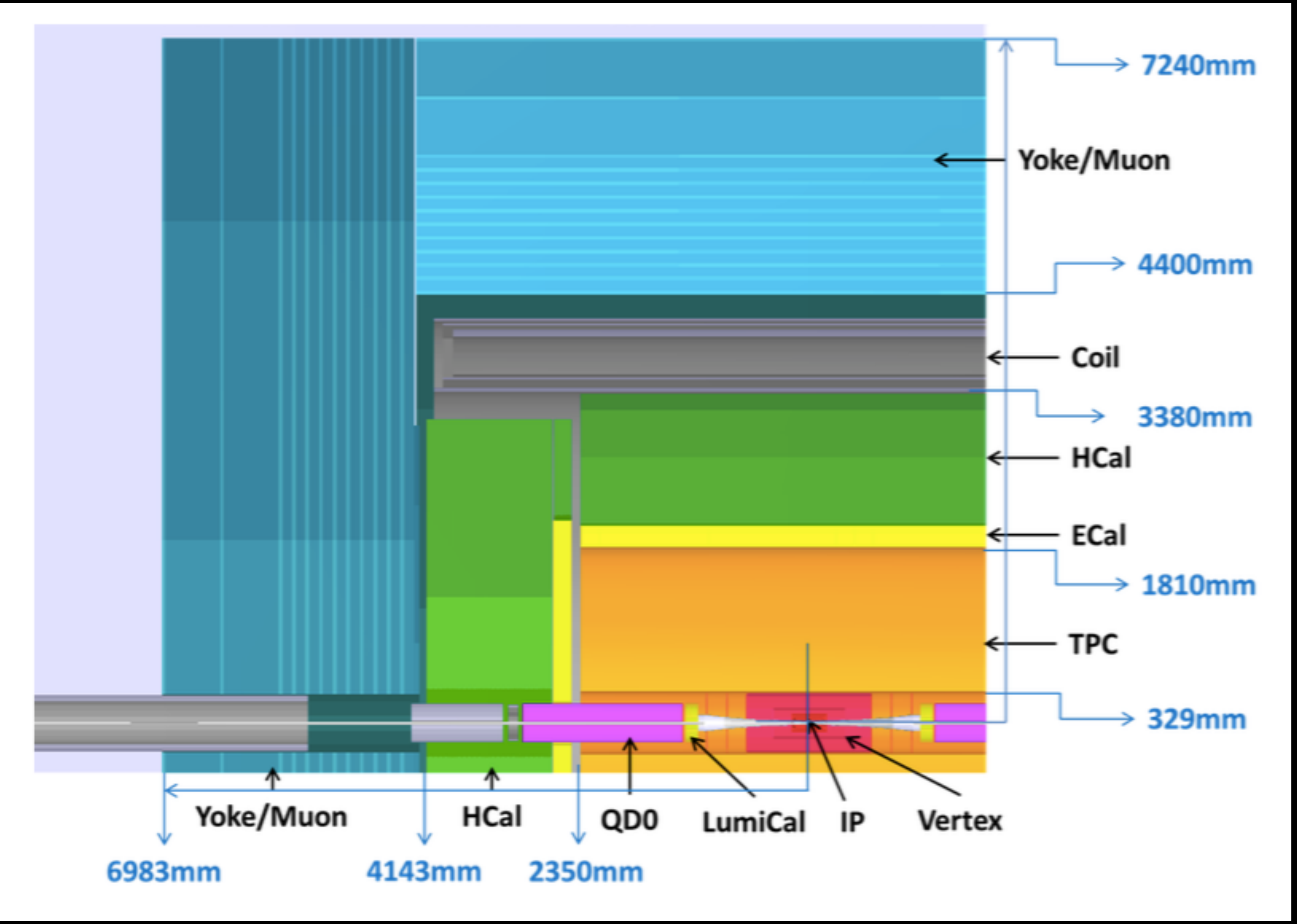
Major concerns being addressed

1. MDI region highly constrained
L* increased to 2.2 m
Compensating magnets

2. Low-material Inner Tracker design

3. TPC as tracker in high-luminosity Z-pole scenario

4. ECAL/HCAL granularity needs
Passive versus active cooling

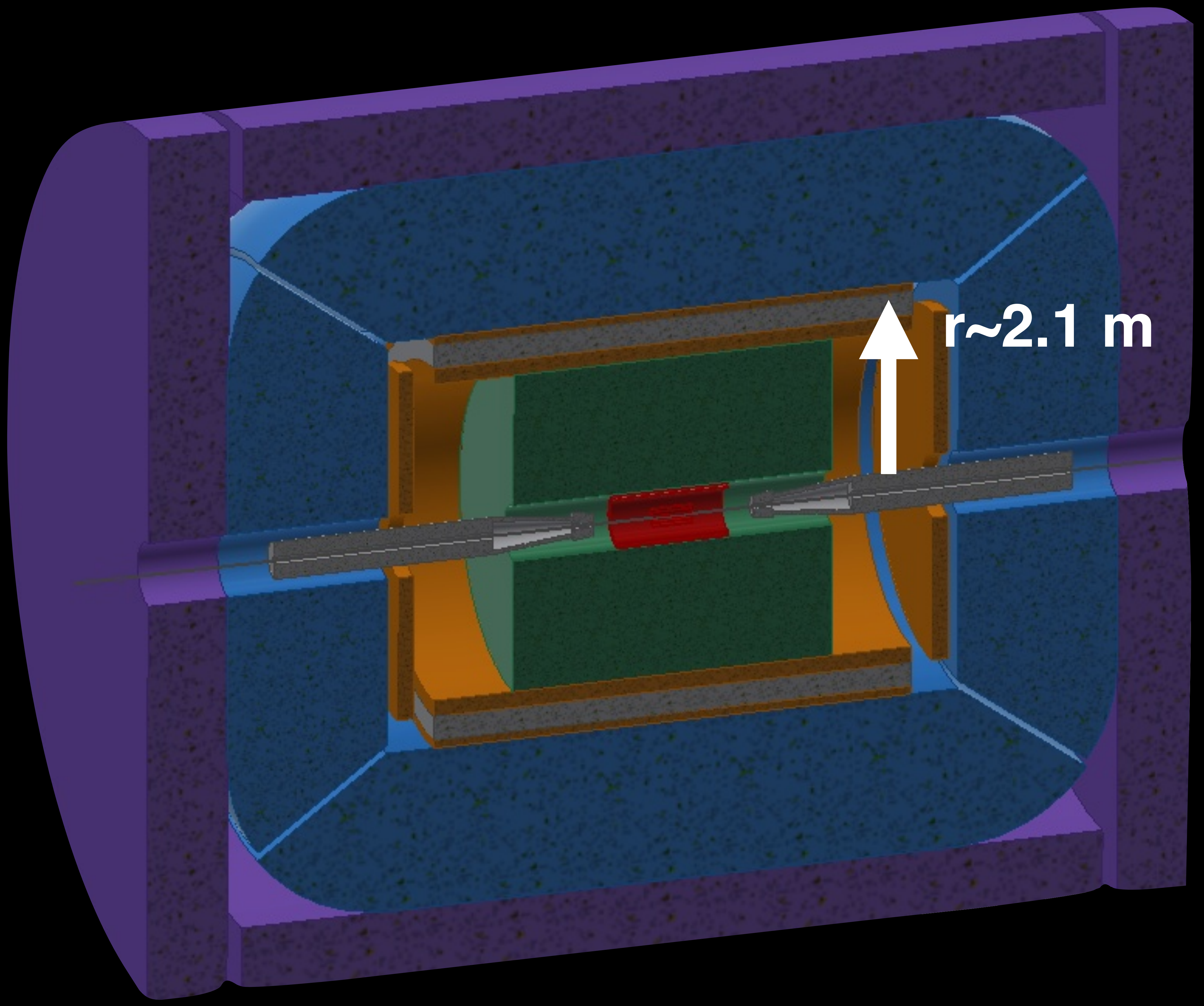


Magnetic Field: 3 Tesla — changed from preCDR

- **Impact parameter resolution**: less than 5 μm ← Flavor tagging
- **Tracking resolution**: $\delta(1/P_t) \sim 2\times10^{-5}$ (GeV^{-1}) ← BR(Higgs → μμ)
- **Jet energy resolution**: $\sigma_E/E \sim 30\%/\sqrt{E}$ ← W/Z dijet mass separation

Low magnetic field detector concept

Proposed by INFN, Italy colleagues



Similar to Concept Detector for FCC-ee

Open for collaboration within China

Magnet: 2 Tesla, 2.1 m radius

Thin (~ 30 cm), low-mass (~0.8 X_0)

Vertex: Similar to CEPC default

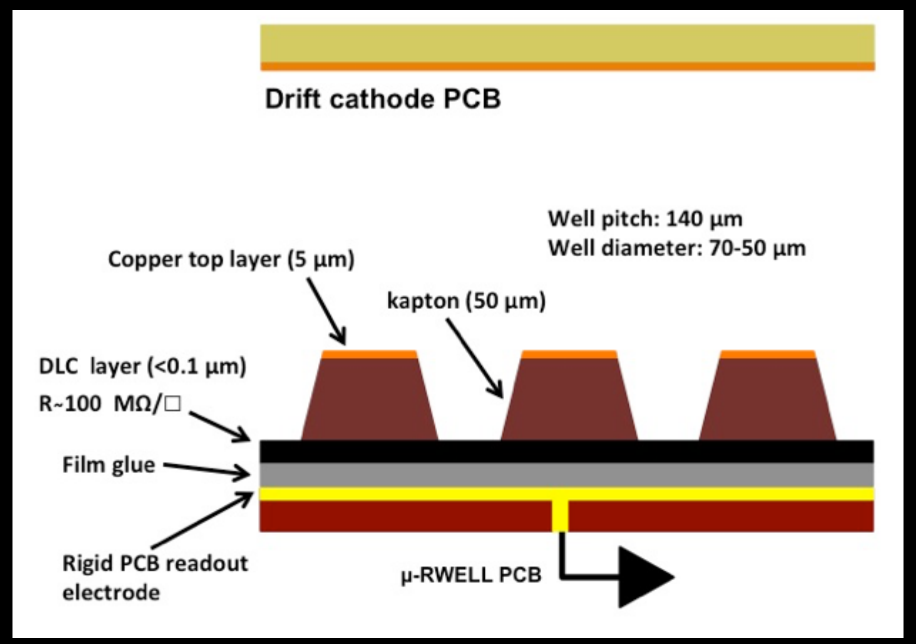
* **Drift chamber: 4 m long; Radius ~30-200 cm**

Preshower: ~1 X_0

* **Dual-readout calorimeter: 2 m/8 λ_{int}**

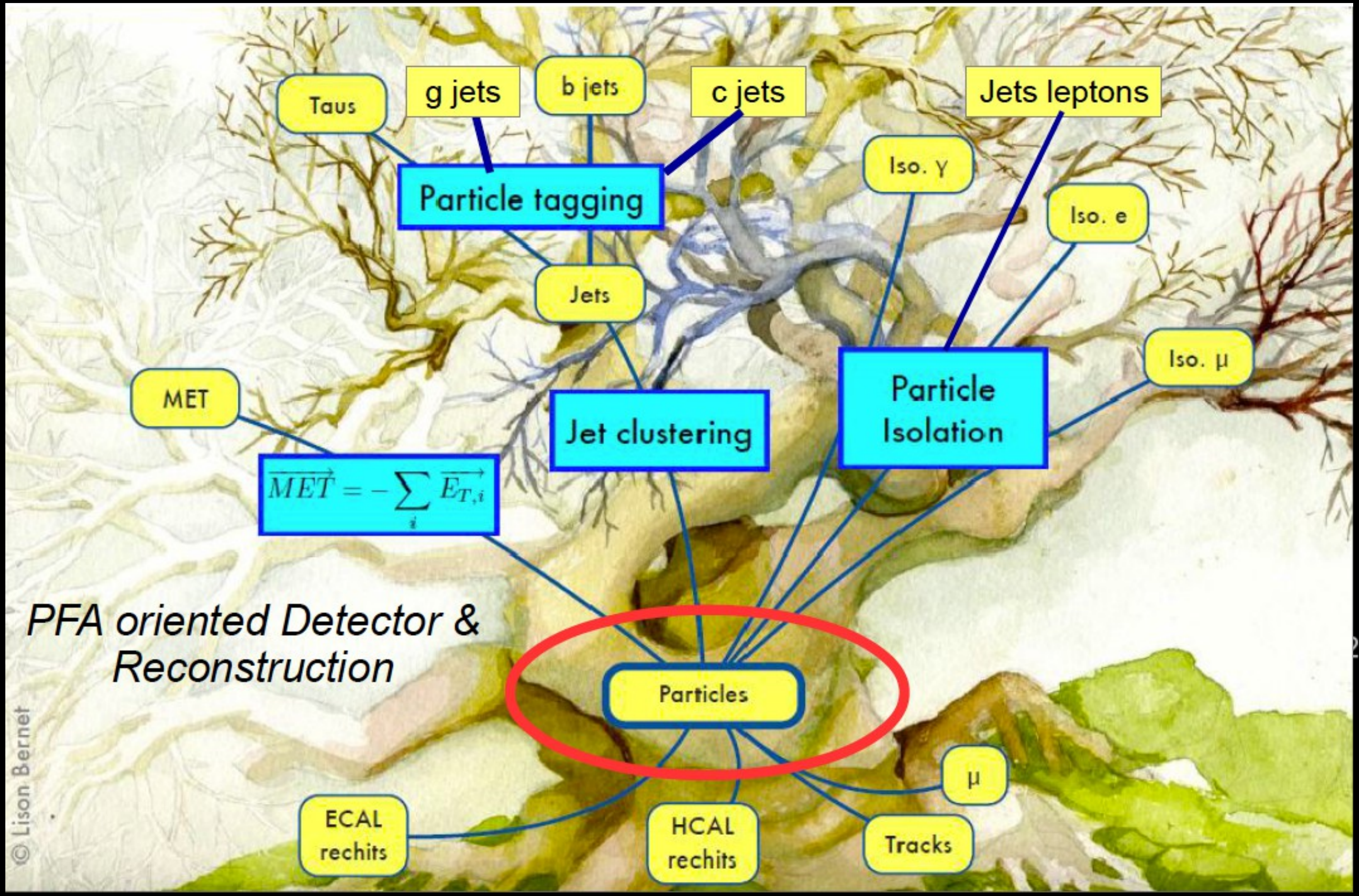
* **(yoke) muon chambers**

New technology proposal: µRwell

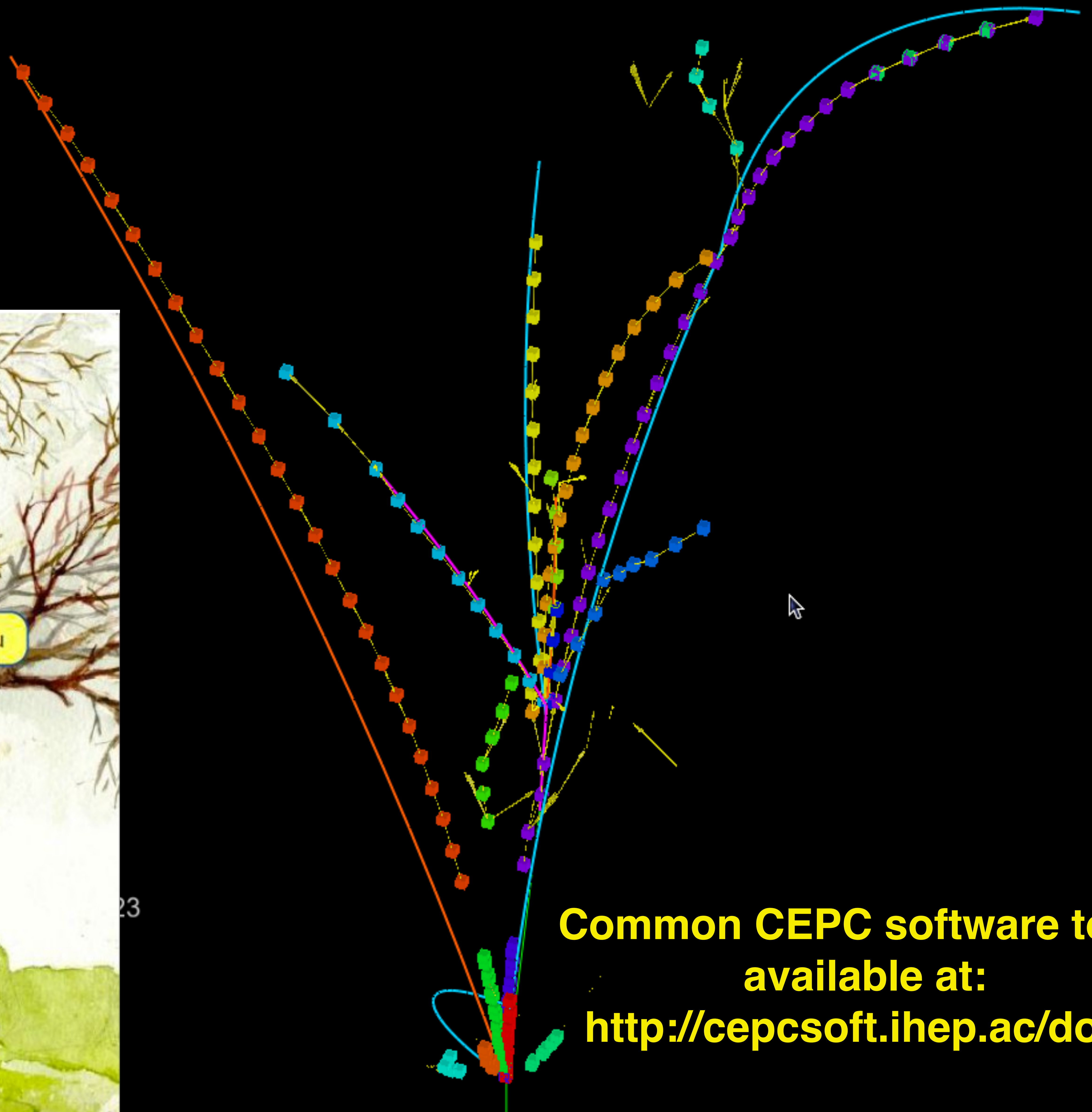


Detector optimization

Optimization based on
particle flow oriented detector
and
full simulation Geant4



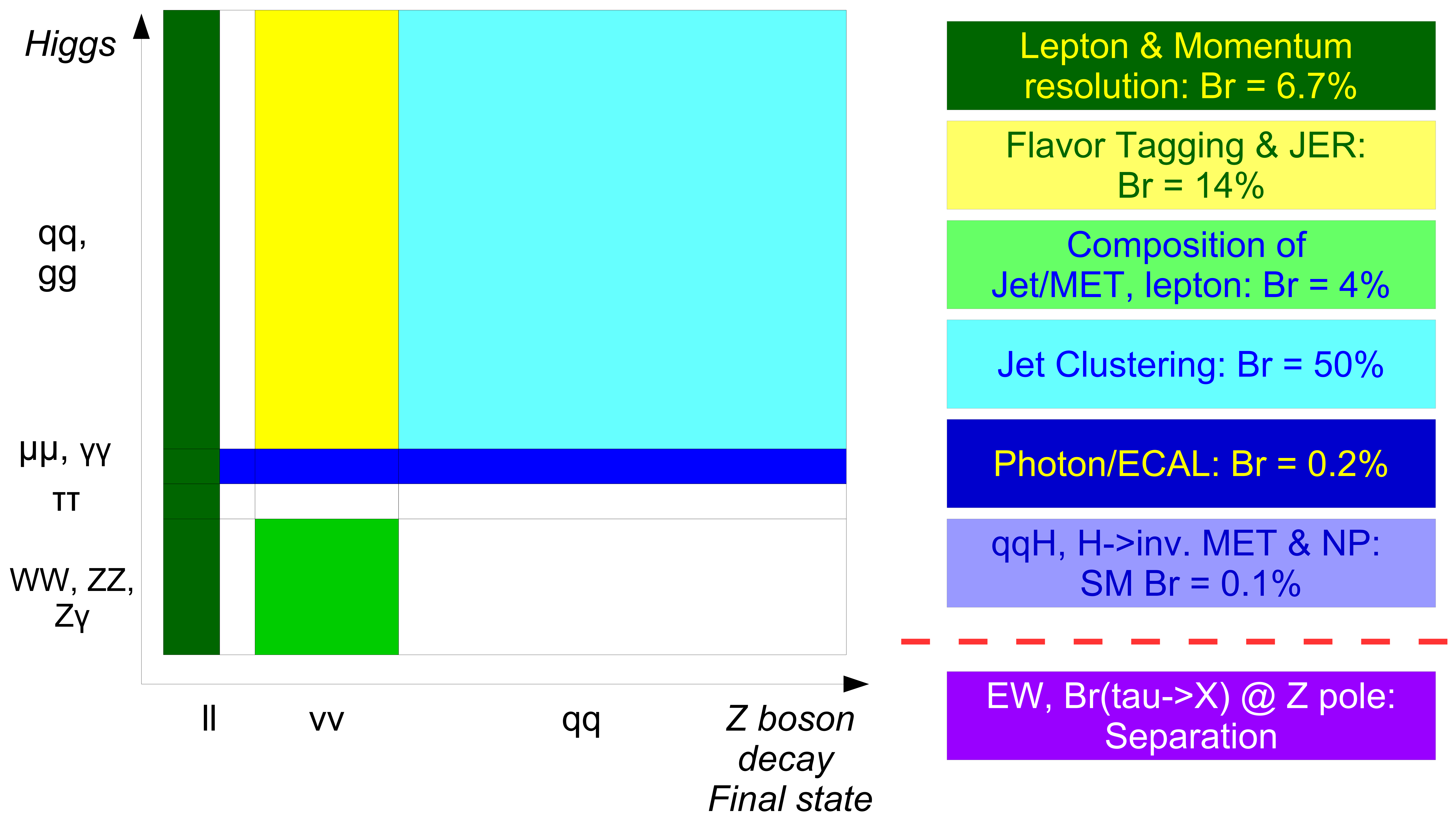
Some studies done with fast simulation



Common CEPC software tools available at: http://cepcsoft.ihep.ac/docs

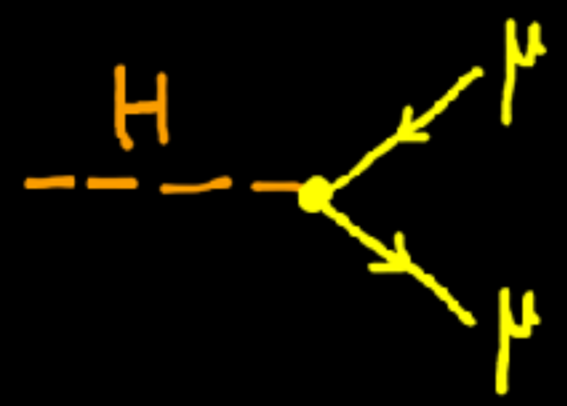
K_L shower reconstructed by the Arbor algorithm

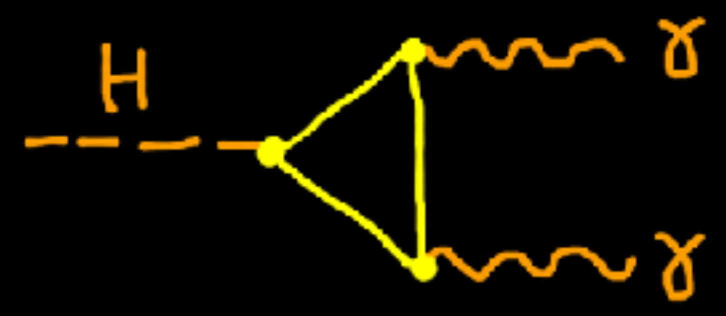
Detector optimization: Benchmark measurements



Detector optimization

	Optimized (CDR)	Comments
B Field	3 Tesla	Required from beam emmitance
TPC radius	1.8 m	Required by Br(H→μμ) measurement
TOF	50 ps	Pi-Kaon separation at Z pole
ECAL thickness	84 mm	Optimized for Br(H->γγ) at 250 GeV
ECAL cell size	10 mm	Maximum for EW measurements, better 5 mm but passive cooling needs 20 mm
ECAL num. layers	25	Depends on silicon sensor thickness
HCAL thickness	1 m	
HCAL num. layers	40	Optimized for Higgs at 250 GeV





Interaction region: Machine Detector Interface

One of the most complicated issue in the CEPC detector design

Full partial double ring ➜

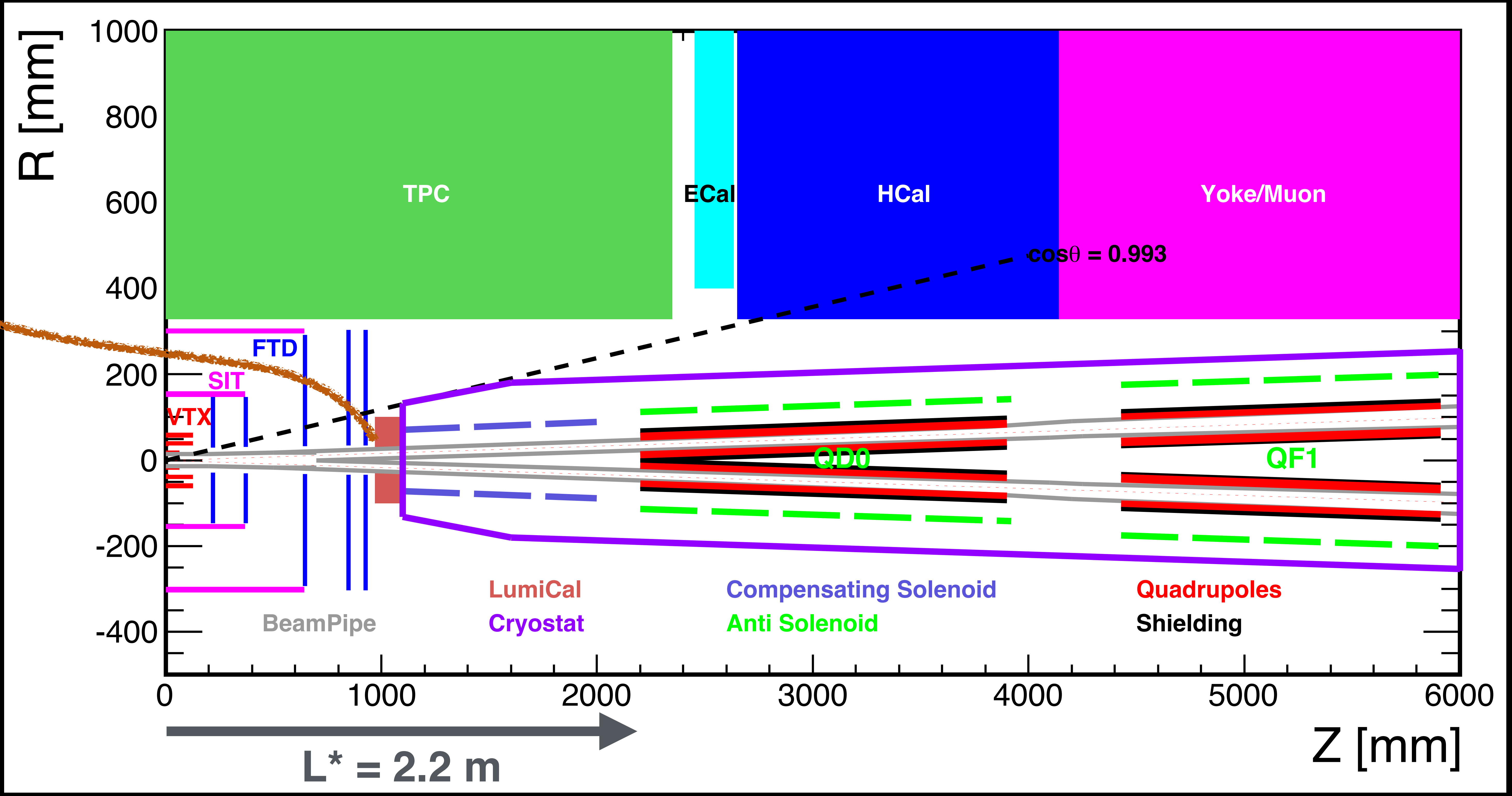
Updated baseline parameters:

- Head-on collision changed to crossing angle of **33 mrad**
- Focal length (**L***) increased from 1.5 m to **2.2 m**
- Solenoid field reduced from 3.5 T to **3 T**

LumiCal

Lumi unc: 1×10^{-3}

(studies lead by Vinca and Academia Sinica)



Challenging engineering design

Magnet	Field Strength	Length	Inner Radius
QD0	136 T/m	1.73m	19 mm

Interaction region: Machine Detector Interface

Machine induced backgrounds

- Radiative Bhabha scattering
- Beam-beam interactions
- Synchrotron radiation
- Beam-gas interactions

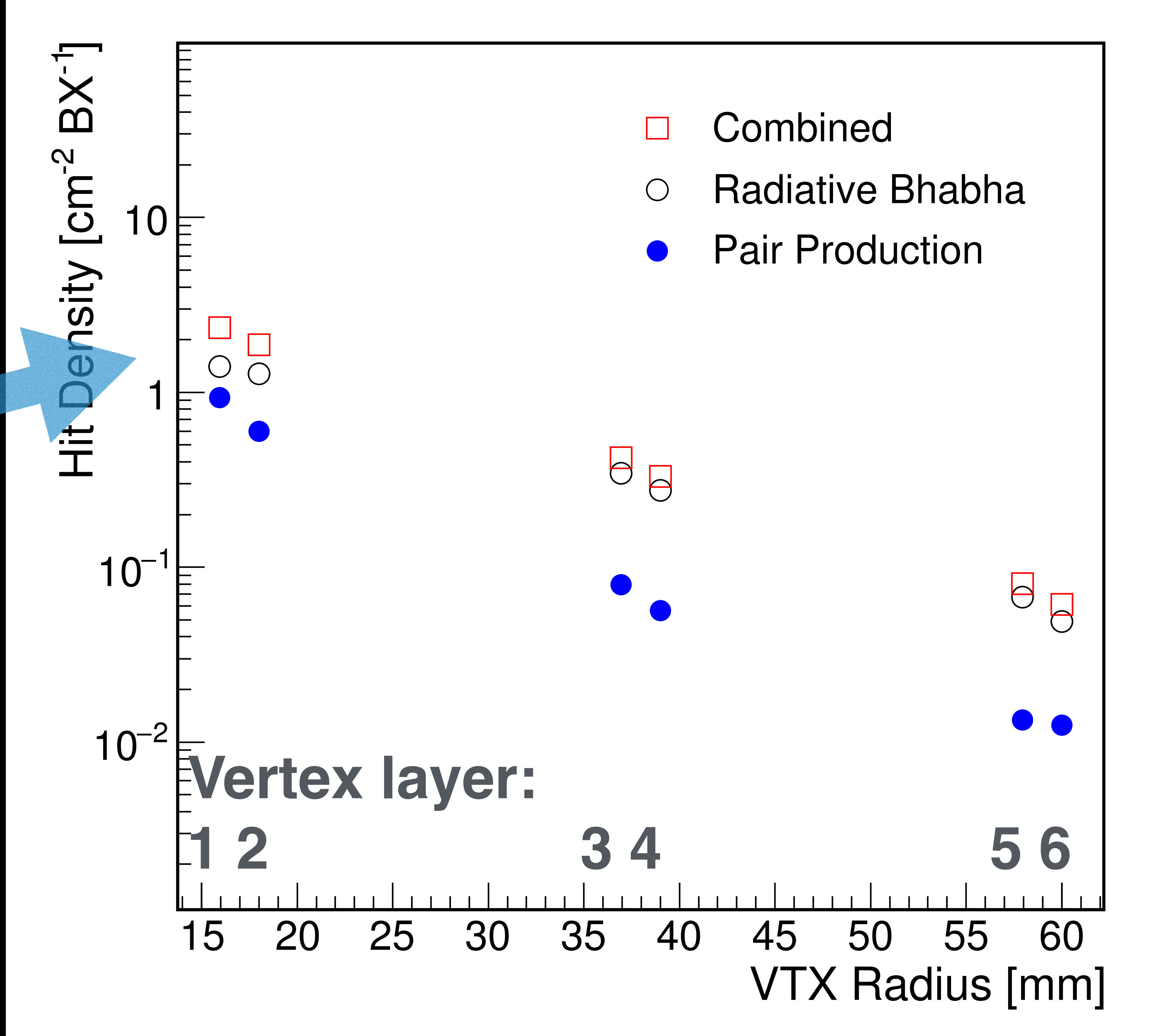
Studies for new configuration being finalized

Higgs operation
(E_{cm} = 240 GeV)

Rates at the inner layer (16 mm):

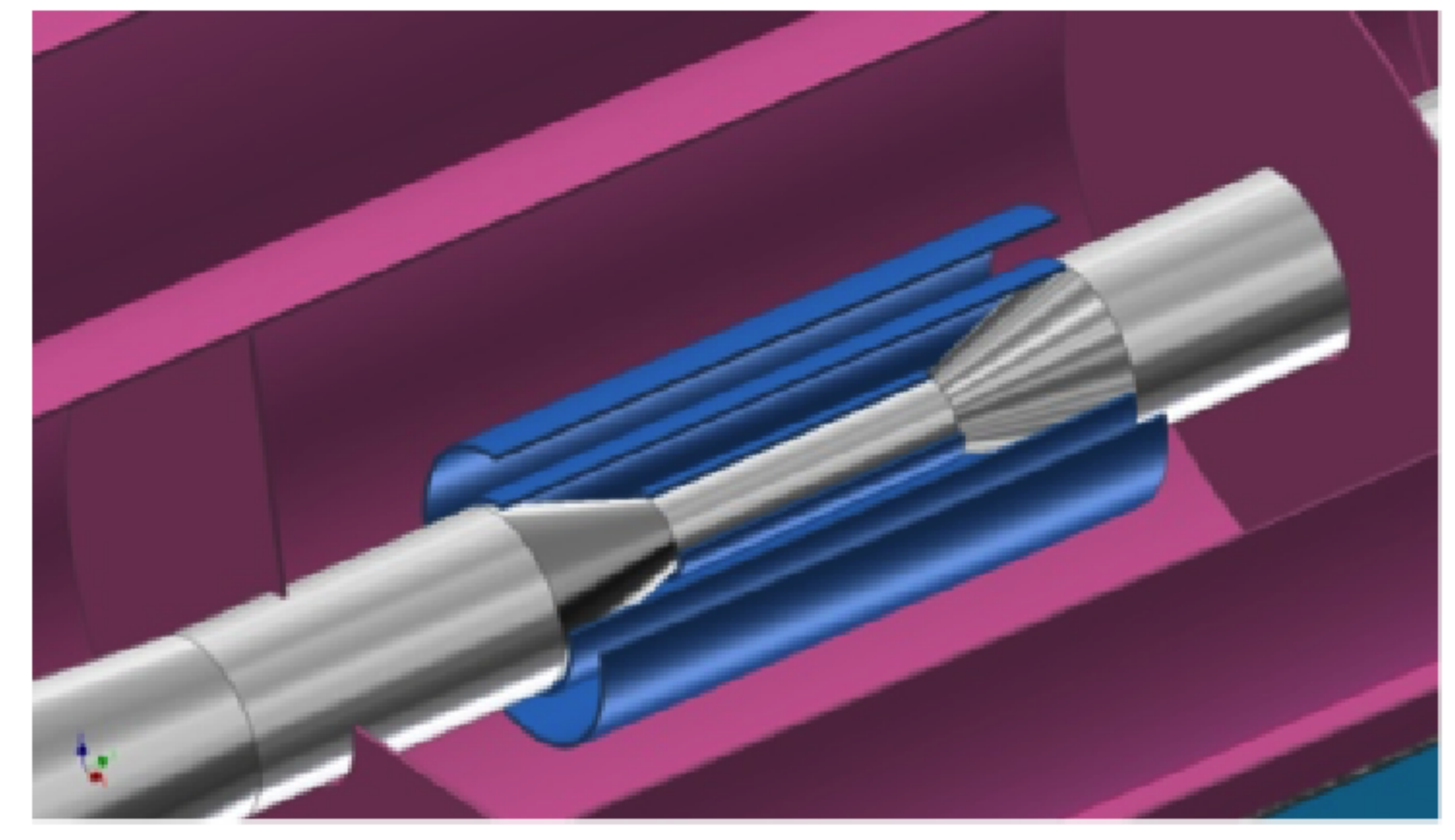
Hit density: ~2.5 hits/cm²/BX
TID: 2.5 MRad/year
NIEL: 10^{12} 1MeV n_{eq}/cm²

(Safety factors of 10 applied)



Baseline Pixel Detector Layout

3-layers of double-sided pixel sensors

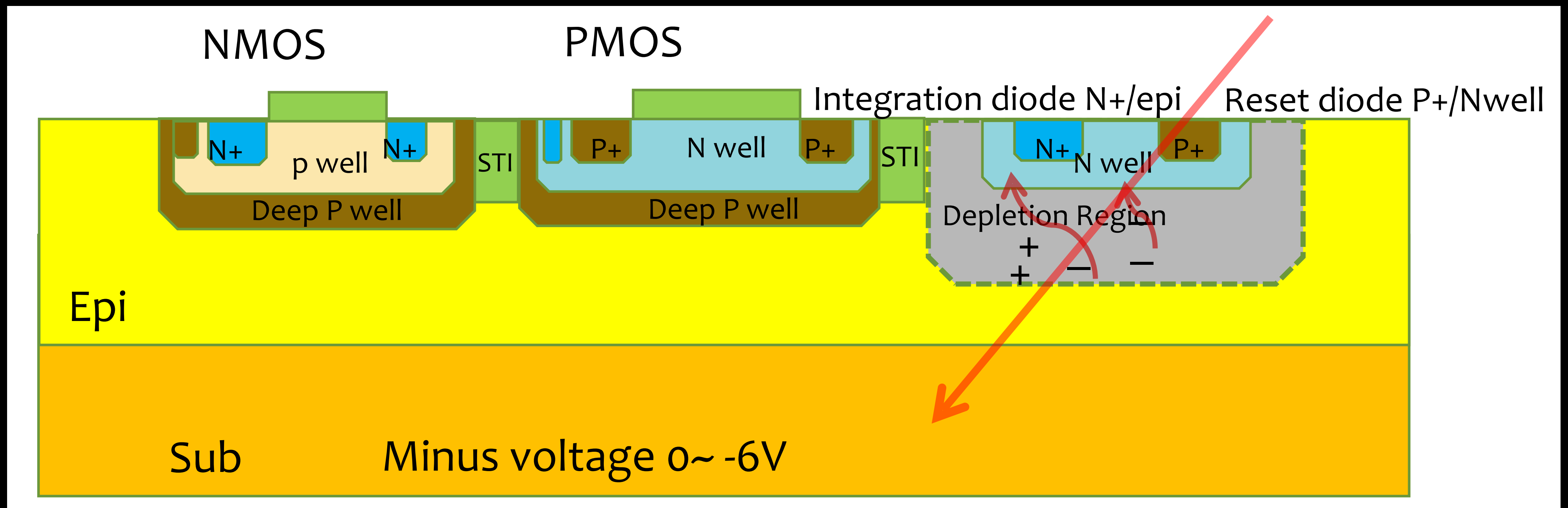


- ✦ ILD-like layout
- ✦ Innermost layer: $\sigma_{SP} = 2.8\ \mu m$
- ✦ Polar angle θ ~ 15 degrees

Implemented in GEANT4 simulation framework (MOKKA)

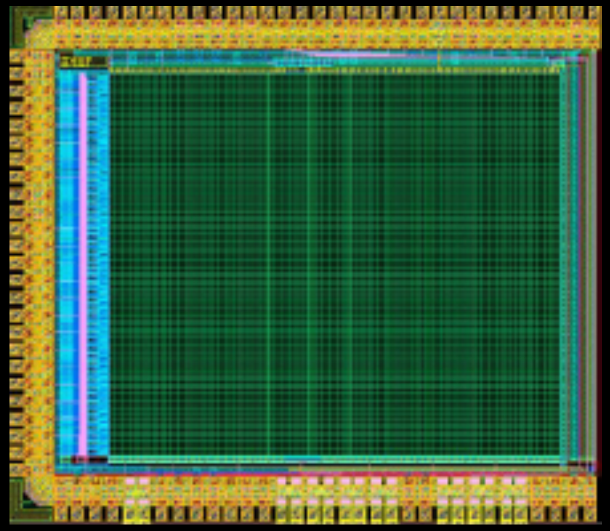
		$R(mm)$	$\lvert z\rvert(mm)$	$\lvert cos\theta\rvert$	$\sigma(\mu m)$	$Readout\ time(us)$
Ladder 1	Layer 1	16	62.5	0.97	2.8	20
	Layer 2	18	62.5	0.96	6	1-10
Ladder 2	Layer 3	37	125.0	0.96	4	20
	Layer 4	39	125.0	0.95	4	20
Ladder 3	Layer 5	58	125.0	0.91	4	20
	Layer 6	60	125.0	0.90	4	20

CMOS pixel sensor (MAPS)



Integrated sensor and readout electronics on the same silicon bulk with "standard" CMOS process:
- low material budget,
- low power consumption,
- low cost …

Current R&D activities



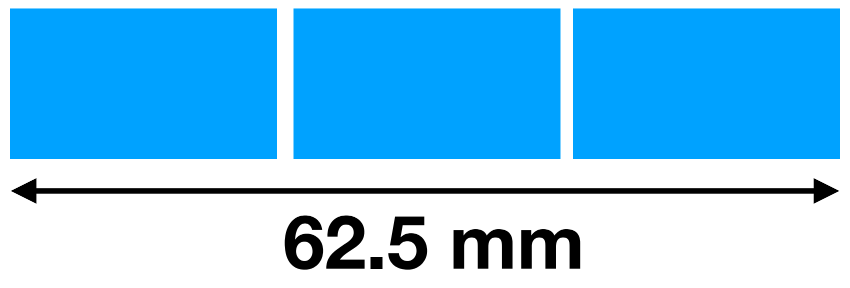
Initial Pixel sensor R&D:

	Process	Smallest pixel size	Chips designed	Observations
CMOS pixel sensor (CPS)	TowerJazz CIS 0.18 μm	22 × 22 μm²	2	Founded by MOST and IHEP
SOI pixel sensor	LAPIS 0.2 μm	16 × 16 μm²	2	Funded by NSFC

- Institutions: CCNU, NWTU, Shandong, Huazhong Universities and IHEP

Pixel Detector prototype:

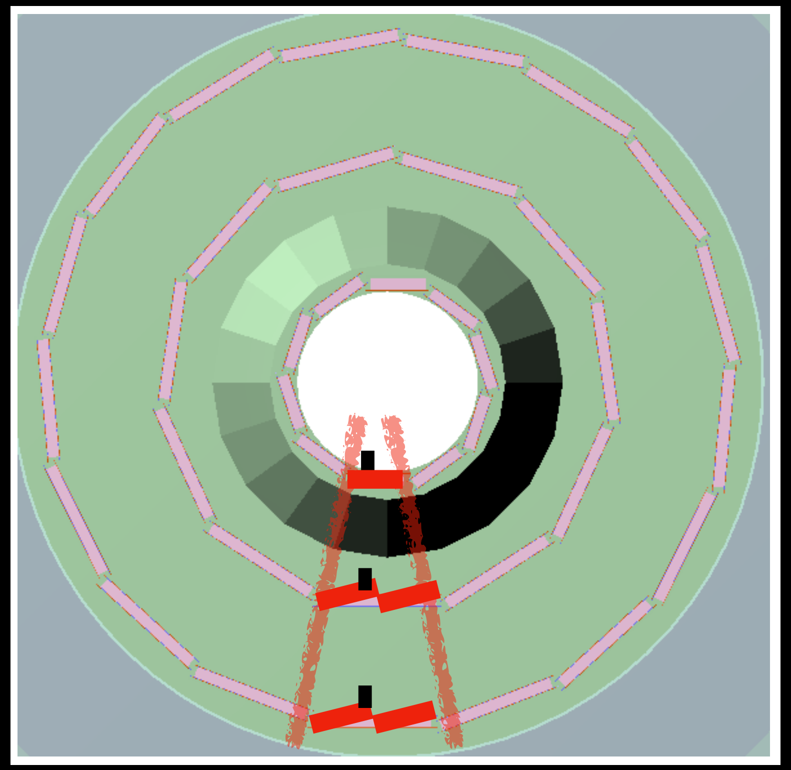
Double sided ladder



Layer 1 (11 mm x 62.5 mm)

Chip size: 11 mm X 20.8 mm

3 X 2 layer = 6 chips



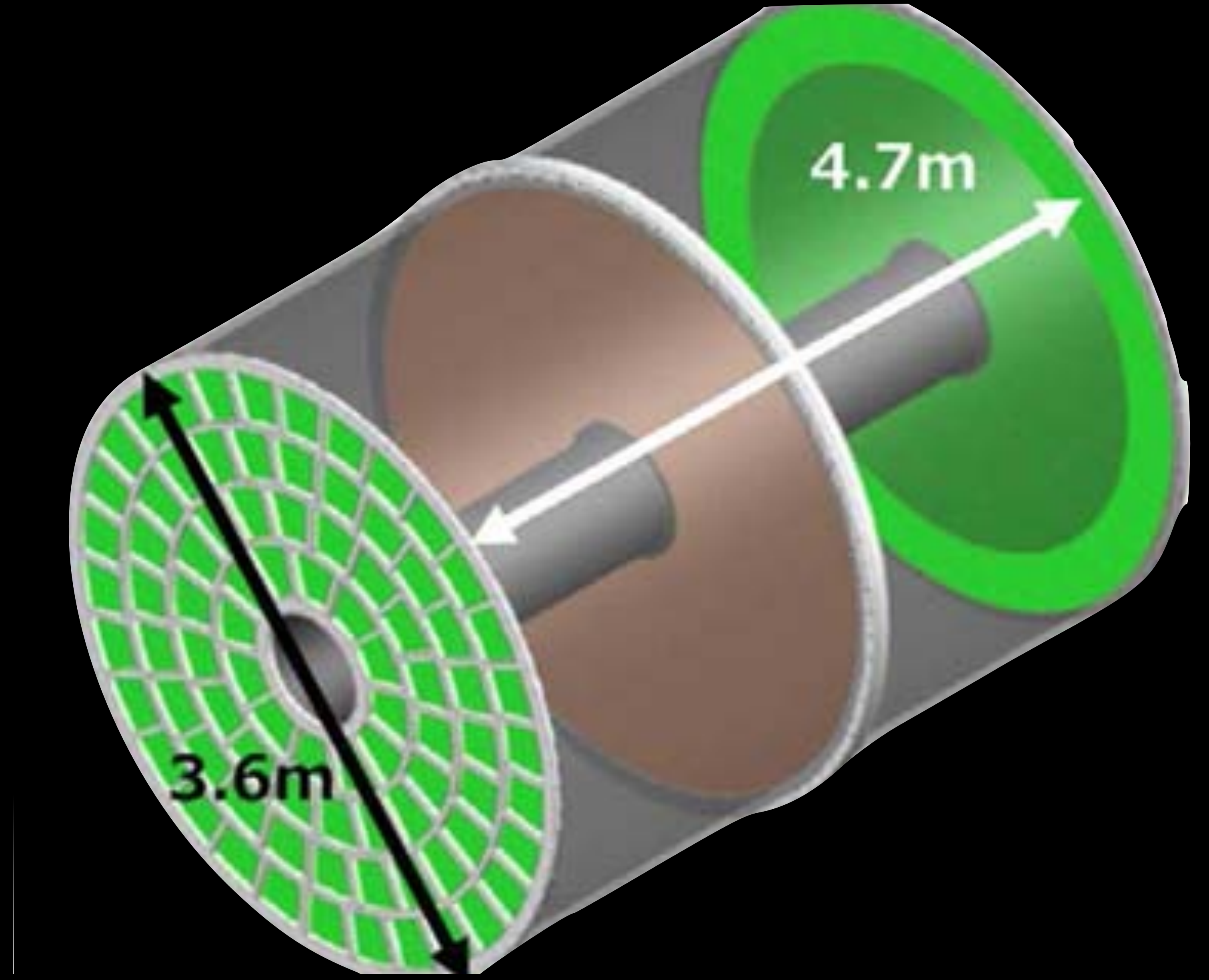
- Develop full size CMOS sensor for use in real size prototype, with good radiation hardness

Time Projection Chamber (TPC)

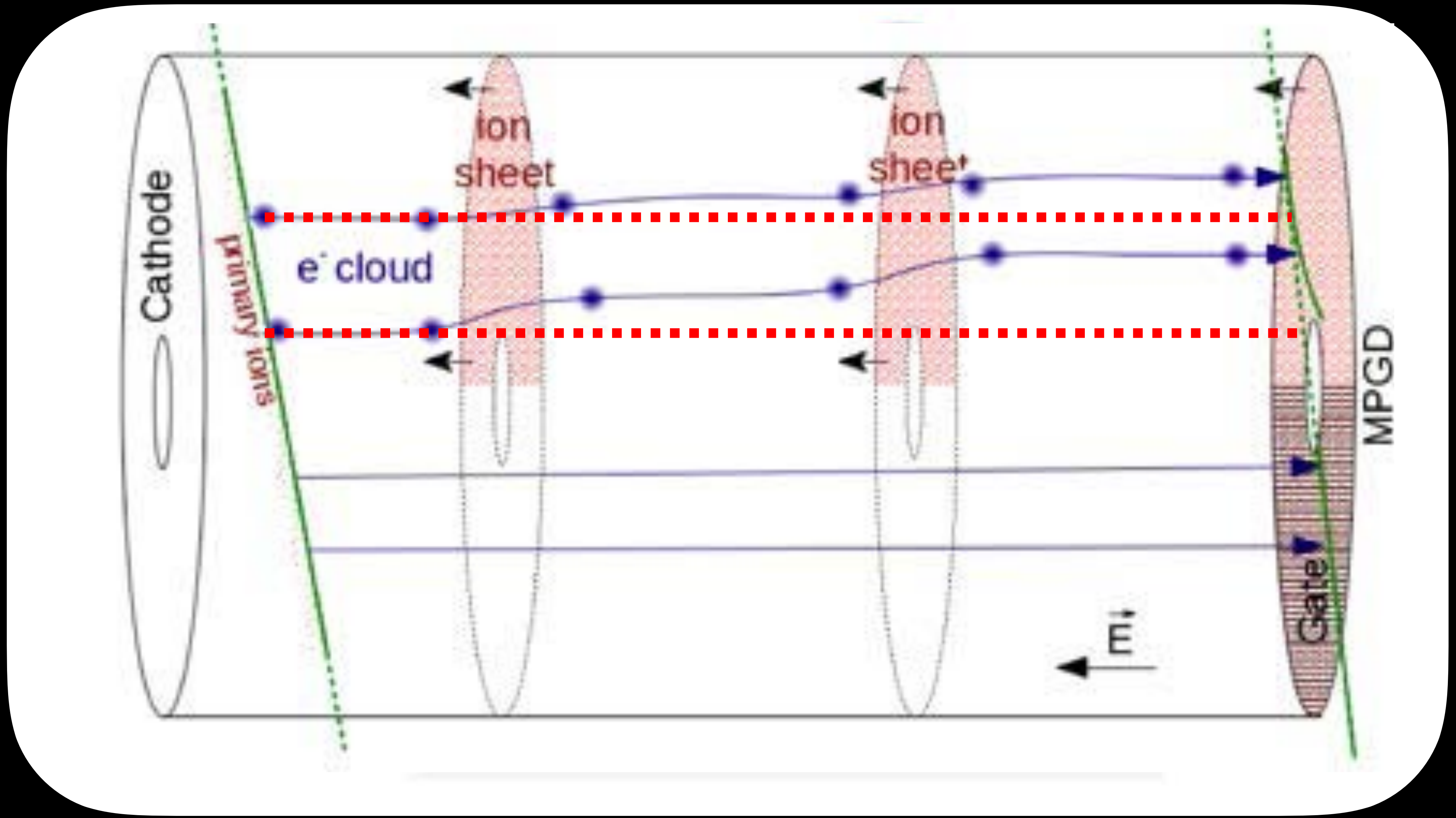
- Allows for particle identification
- Low material budget:
  - 0.05 X_0 including outfield cage in r
  - 0.25 X_0 for readout endcaps in Z
- 3 Tesla magnetic field —> reduces diffusion of drifting electrons
- Position resolution: ~100 μm in rϕ
- dE/dx resolution: 5%
- GEM and Micromegas as readout
- **Problem**: Ion Back Flow —> track distortion

Operation at L > 2 × 10^{34} cm^{-2} s^{-1} being studied

TPC detector concept



Prototype built

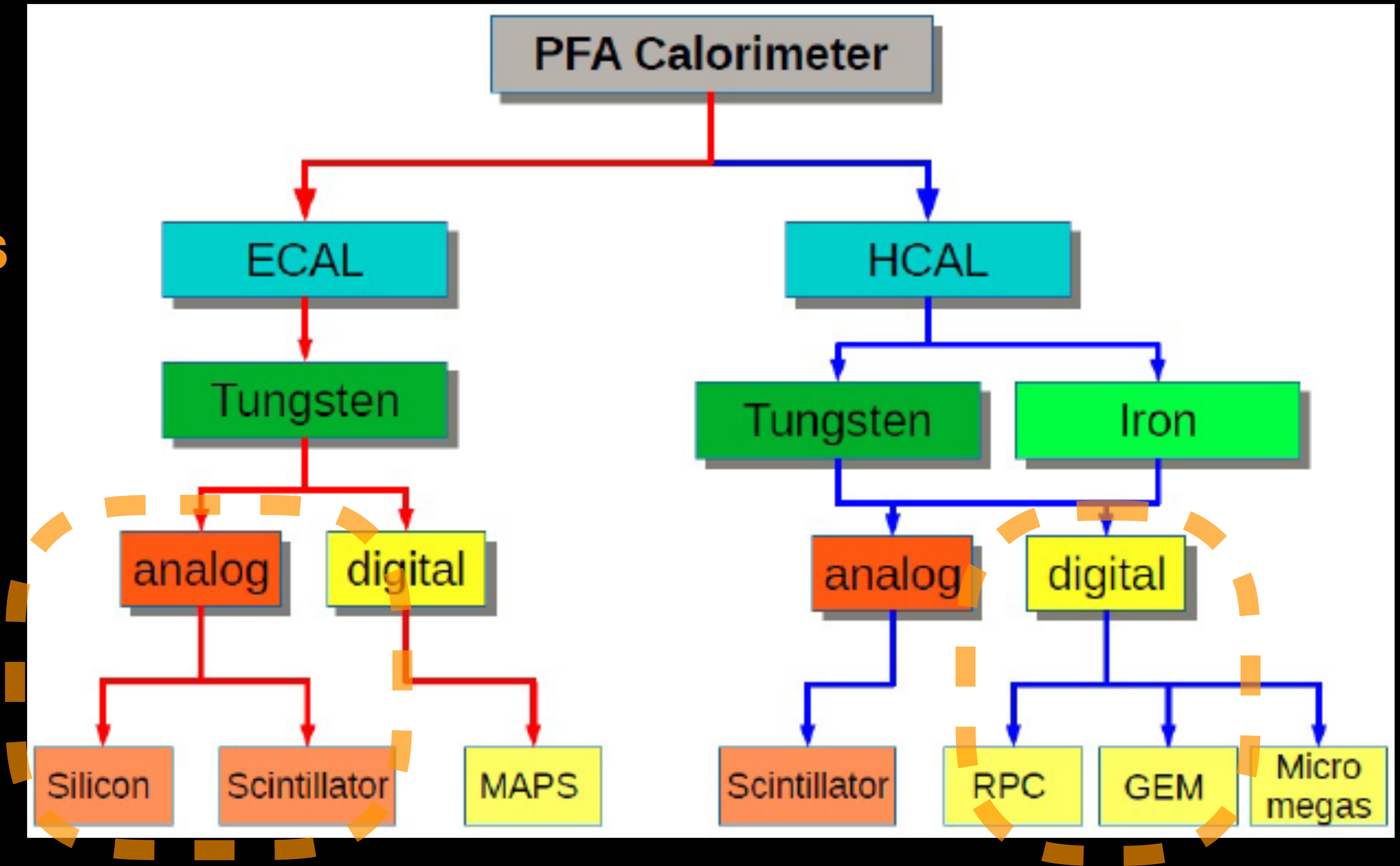


- R&D by IHEP, Tsinghua and Shandong
  - Funded by MOST and NSFC

Calorimeter options

Chinese institutions have been focusing on Particle Flow calorimeters

R&D supported by MOST, NSFC and IHEP seed funding



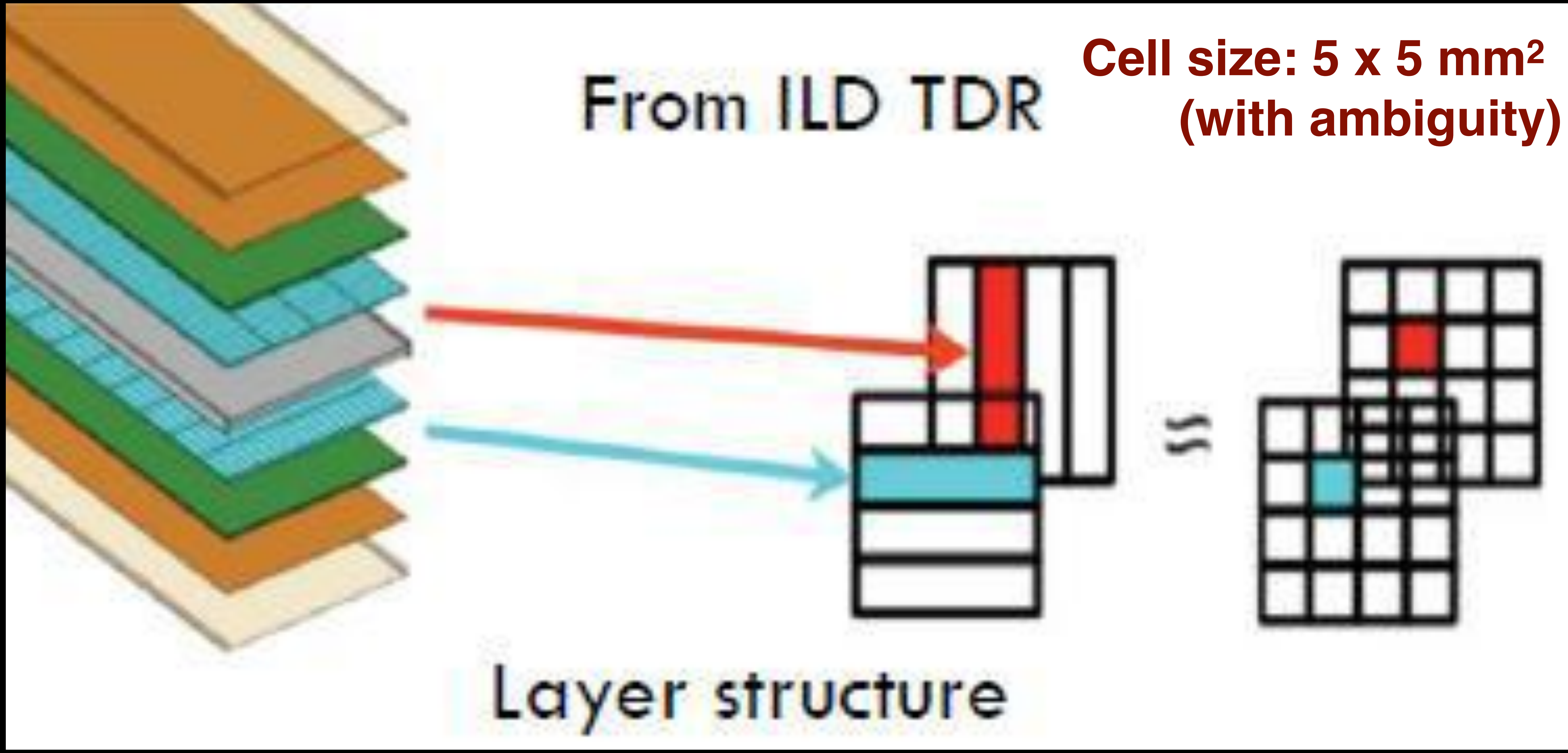
Electromagnetic	ECAL with Silicon and Tungsten (LLR, France) (*) ECAL with Scintillator+SiPM and Tungsten (IHEP + USTC)
Hadronic	(*) SDHCAL with RPC and Stainless Steel (SJTU + IPNL, France) SDHCAL with ThGEM/GEM and Stainless Steel (IHEP + UCAS + USTC) (*) HCAL with Scintillator+SiPM and Stainless Steel (IHEP + USTC + SJTU)
New →	(*) Dual readout calorimeters (INFN, Italy + Iowa, USA)

ECAL Calorimeter — Particle Flow Calorimeter

Scintillator-Tungsten Sandwich ECAL

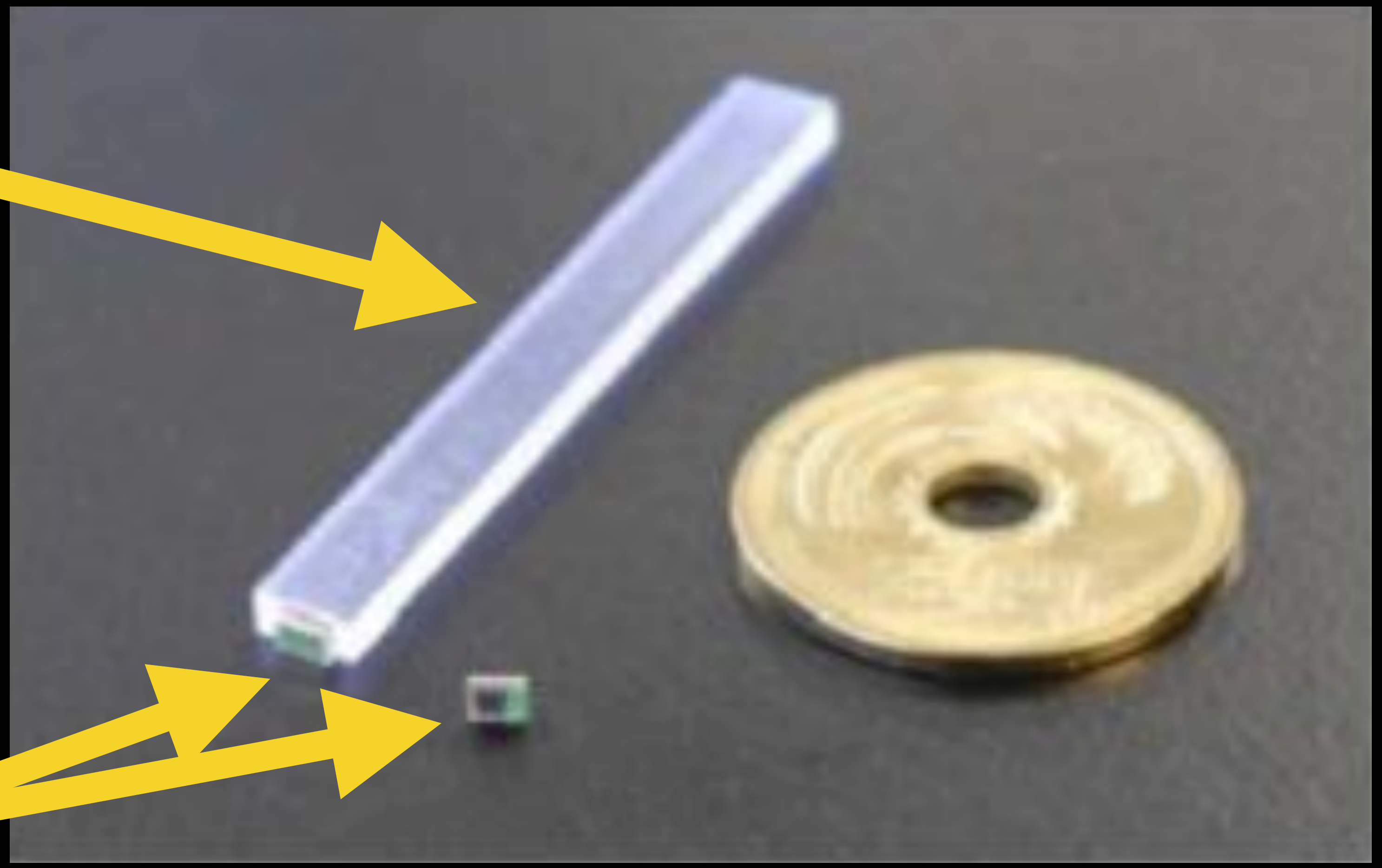
Superlayer (7 mm) is made of:

- 3 mm thick: Tungsten plate
- 2 mm thick: 5 x 45 mm^2
- 2 mm thick: Readout/service layer



Plastic scintillator
5 x 45 mm^2 (2 mm thick)

SiPM



R&D on-going:

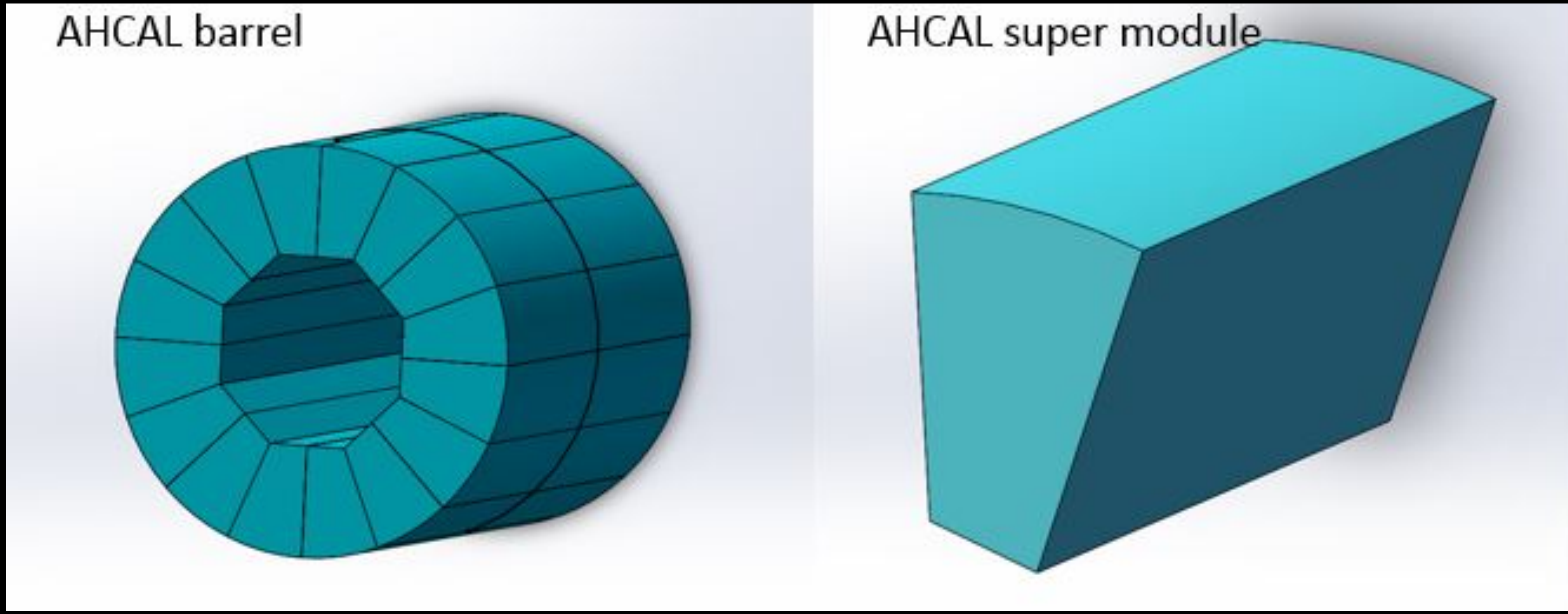
- SiPM dynamic range
- Scintillator strip non-uniformity
- Coupling of SiPM and scintillator

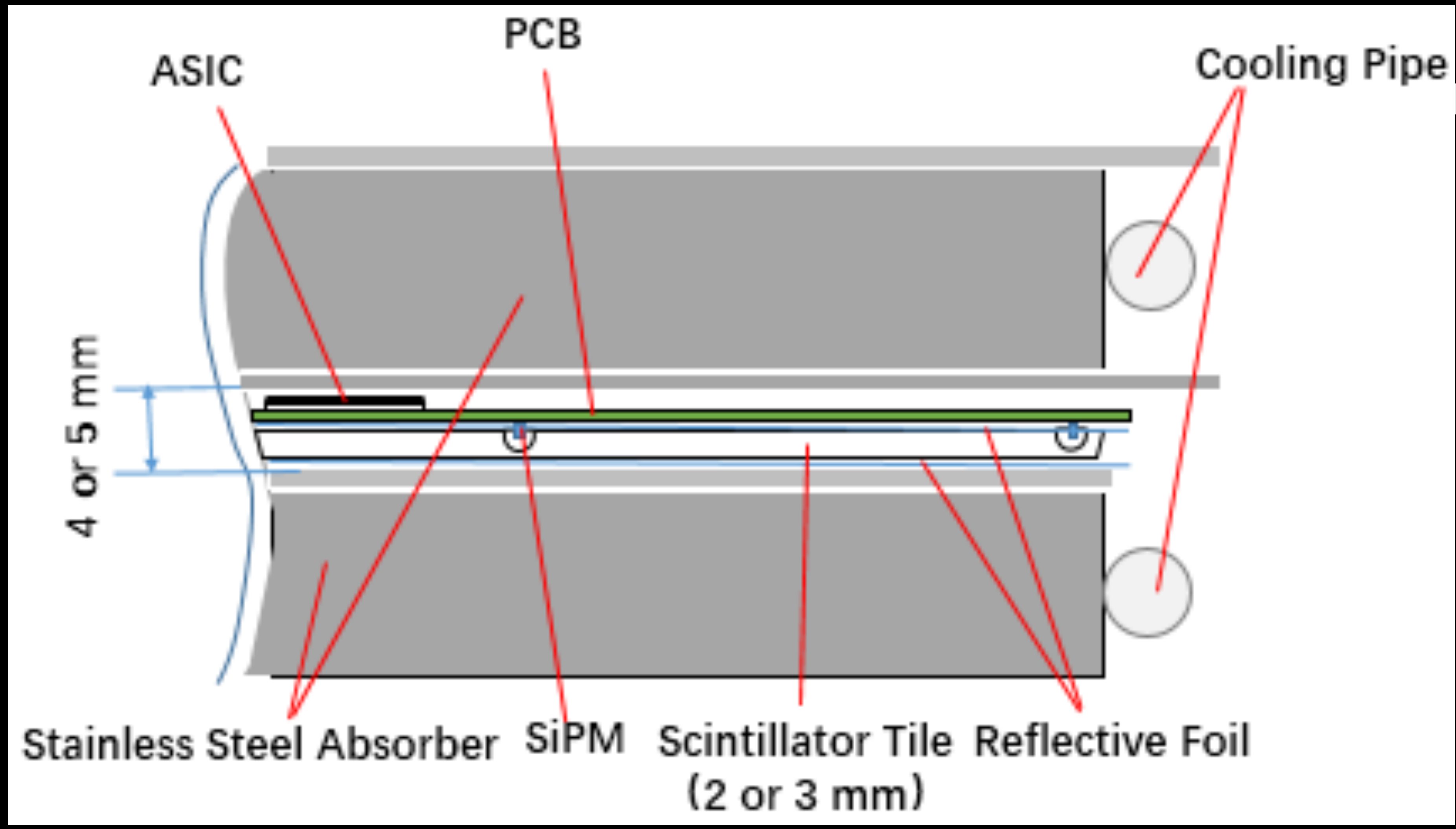
Mini-prototype tested on testbeam at the IHEP

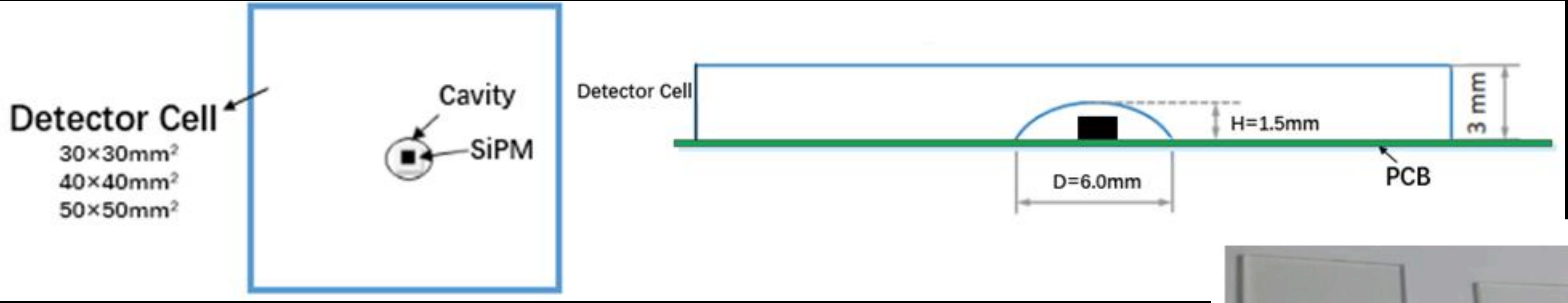
HCAL Calorimeter — Particle Flow Calorimeter

Scintillator and SiPM HCAL (AHCAL)

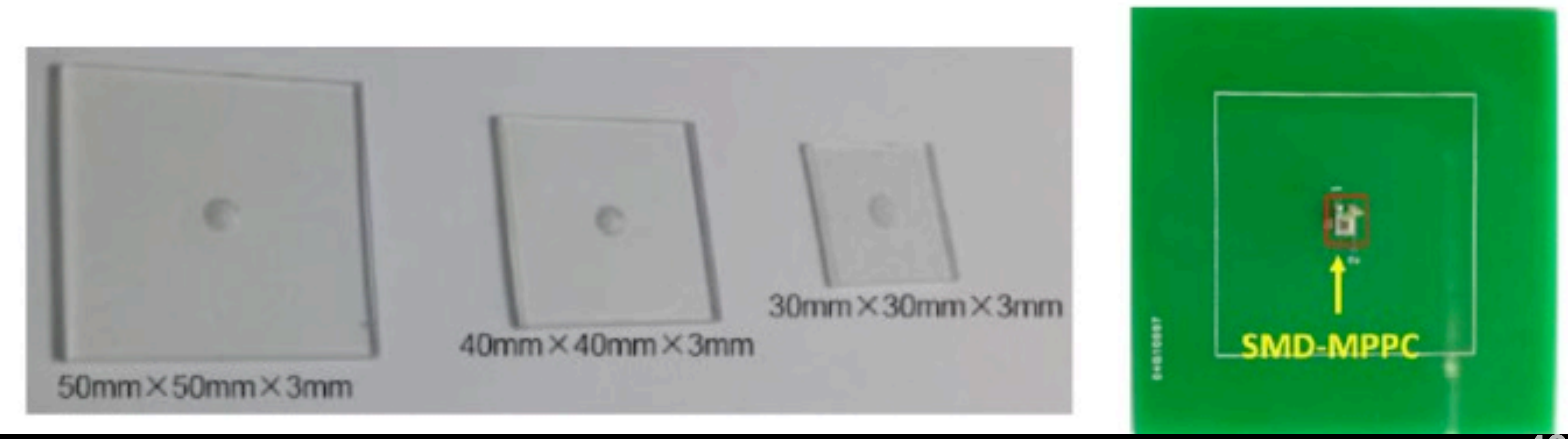
32 super modules **40 layers**







Readout channels:
~ 5 Million (30 x 30 mm²)
~ 2.8 Million (40 x 40 mm²)

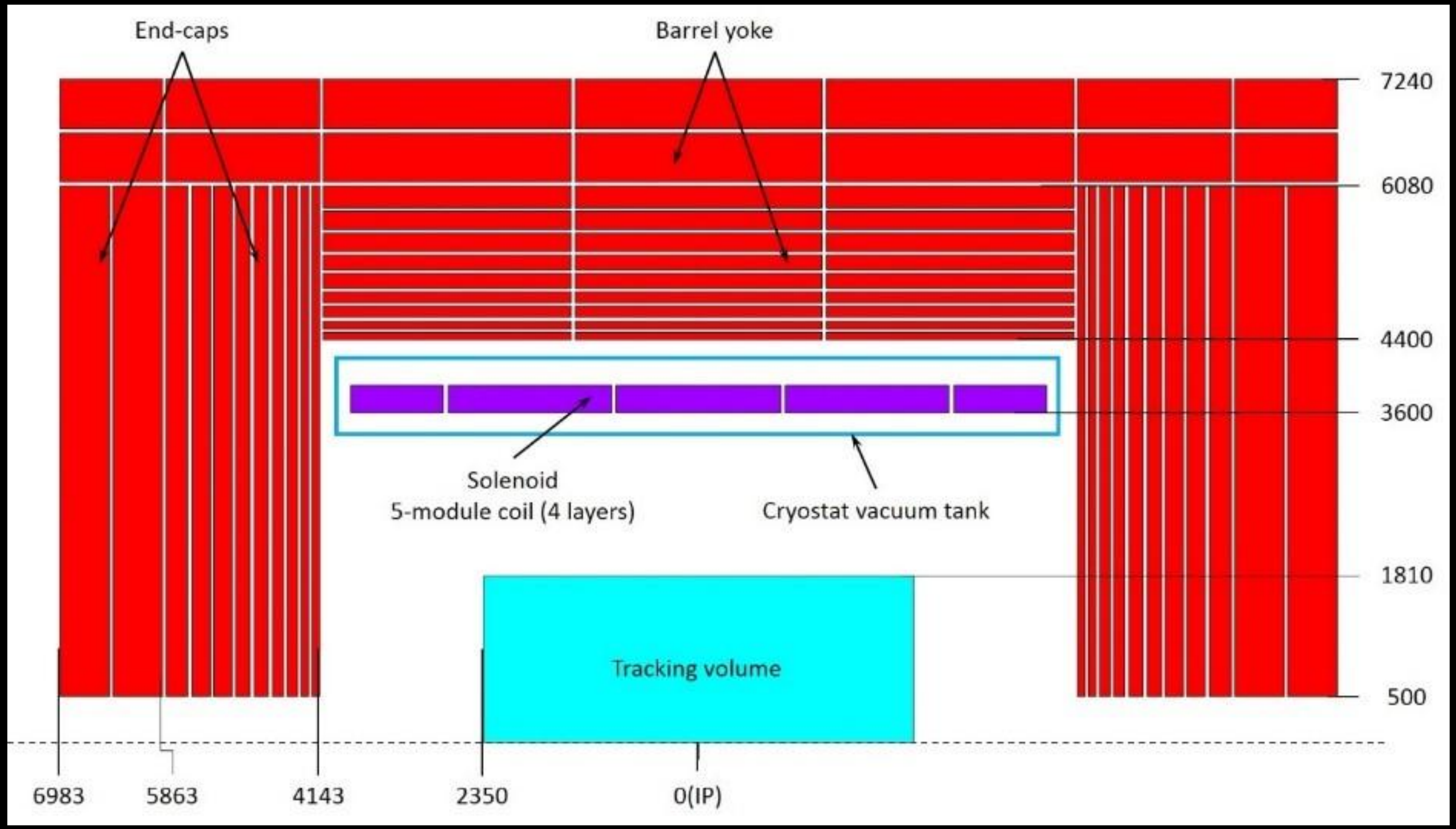


Prototype to be built: MOST (2018-2022)

0.5×0.5 m² , 35 layer (4λ), 3×3 cm² module

Superconductor solenoid development

Updated design done for 3 Tesla field (down from 3.5 T)



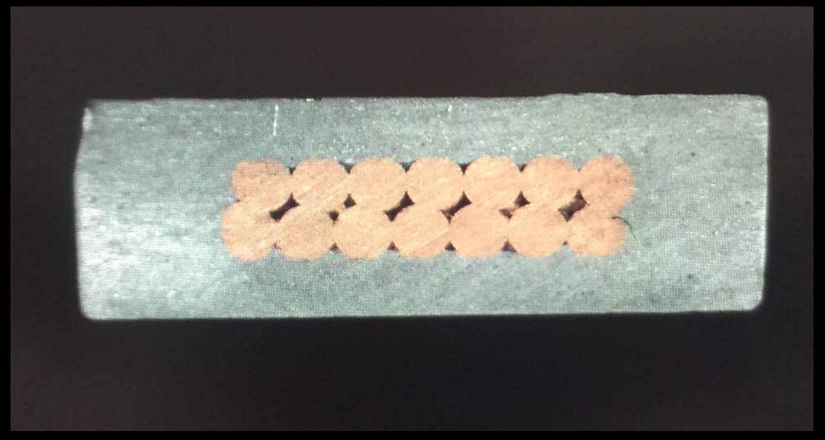
Main parameters of solenoid coil

Central magnetic field	3 T
Operating current	15779 A
Stored energy	1.3 GJ
Inductance	10.46 H
Coil radius	3.6-3.9 m
Coil length	7.6 m
Cable length	30.35 km

Design for 2 Tesla magnet presents no problems

Double-solenoid design also available

Default is NbTi Rutherford SC cable (4.2K)
Solutions with High-Temperature SC cable also being considered (YBCO, 20K)



CEPC Accelerator CDR Completed

CEPC accelerator CDR completed in June 2018 (to be printed in July 2018)

➡ Executive Summary

1. Introduction
2. Machine Layout and Performance
3. Operation Scenarios
4. CEPC Booster
5. CEPC Linac
6. Systems Common to the CEPC Linac, Booster and Collider
7. Super Proton Proton Collider
8. Conventional Facilities
9. Environment, Health and Safety
10. R&D Program
11. Project Plan, Cost and Schedule

Appendix 1: CEPC Parameter List

Appendix 2: CEPC Technical Component List

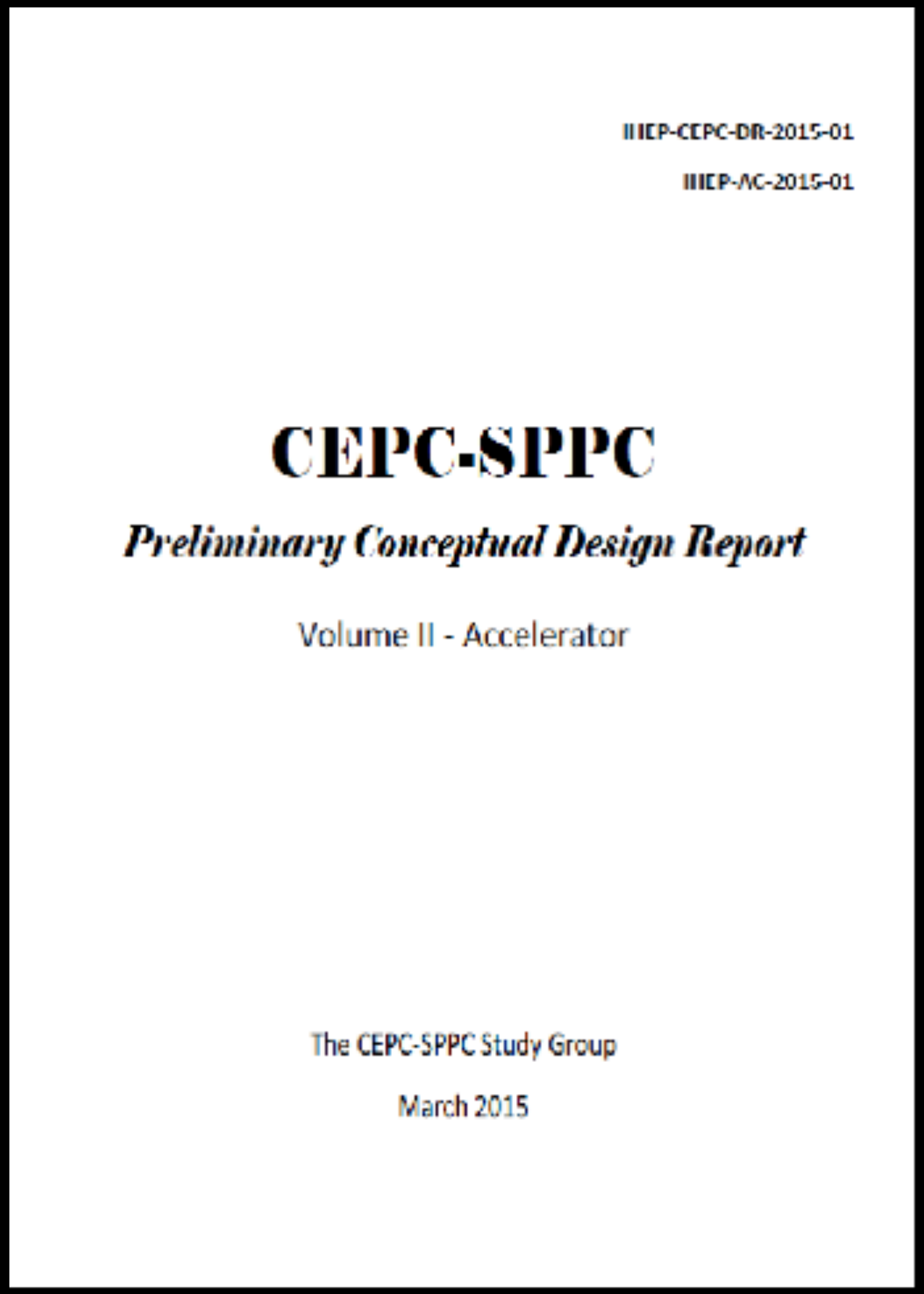
Appendix 3: CEPC Electric Power Requirement

Appendix 4: Operation for High Intensity γ-ray Source

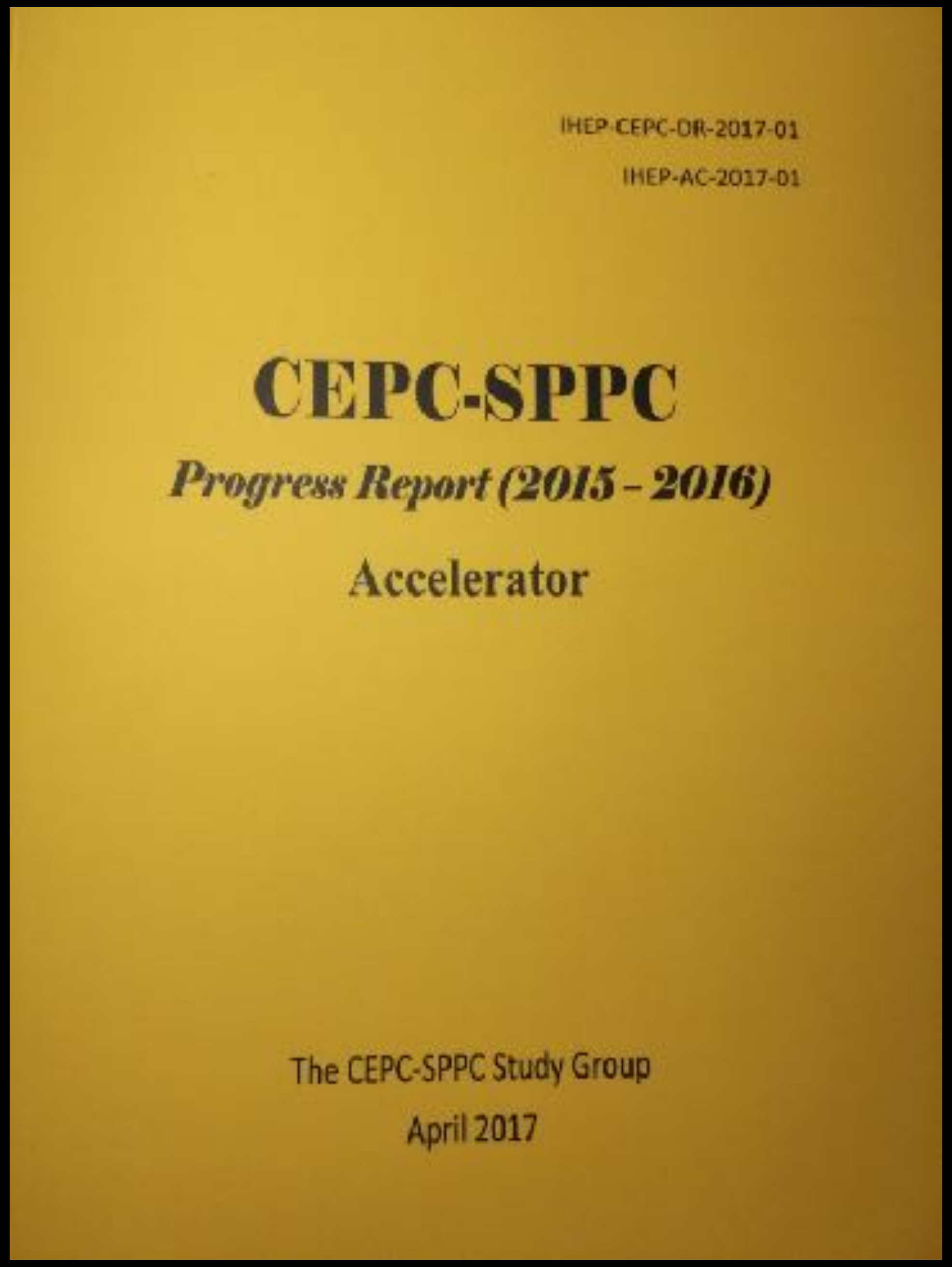
Appendix 5: Advanced Partial Double Ring

Appendix 6: CEPC Injector Based on Plasma Wakefield Accelerator

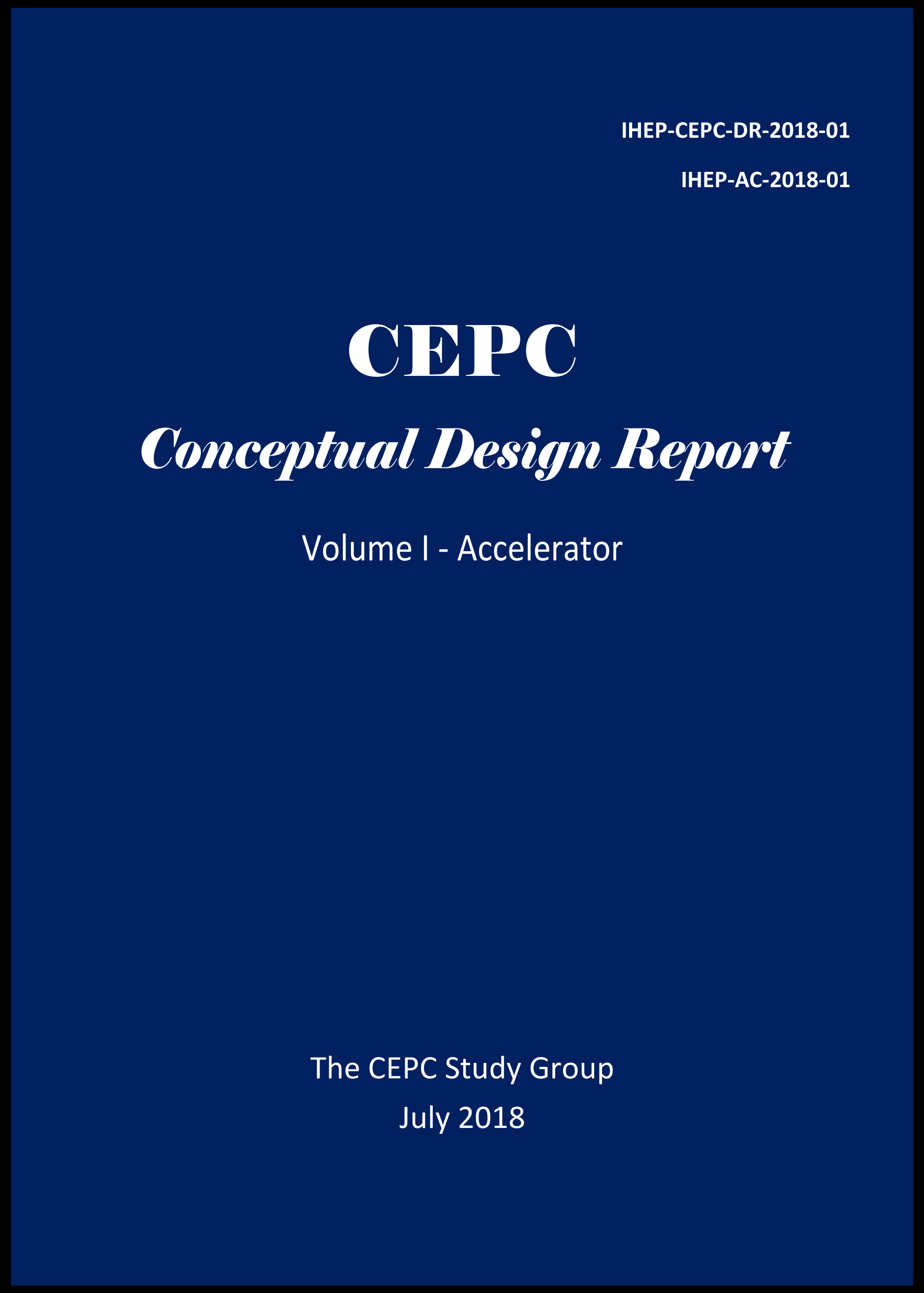
Appendix 7: International Review Report



March 2015



April 2017



July 2018

Physics and Detector CDR to follow soon afterwards

(Need to adapt to recent modifications)

CEPC “optimistic” Schedule

- Design issues
- R&D items
- preCDR

- Design, funding
- R&D program
- Intl. collaboration
- Site study

- Seek approval, site decision
- Construction during 14th 5-year plan
- Commissioning

- CEPC data-taking starts before the LHC program ends
- Possibly concurrent with the ILC program

CEPC Funding in recent years

IHEP seed money
11 M CNY/3 year (2015-2017)

R&D Funding - NSFC

Increasing support for CEPC D+RDby NSFC
5 projects (2015); 7 projects(2016)

CEPC相关基金名称（2015-2016）	基金类型	负责人	承担单位
高精度气体径迹探测器及激光校正的研究 (2015)	重点基金	李玉兰/陈元柏	清华大学/高能物理研究所 Tsinghua IHEP
成像型电磁量能器关键技术研究(2016)	重点基金	刘树彬	中国科技大学 USTC
CEPC局部双环对撞区挡板系统设计及螺线管场补偿 (2016)	面上基金	白莎	高能物理研究所
用于顶点探测器的高分辨、低功耗SOI像素芯片的若干关键问题的研究(2015)	面上基金	卢云鹏	高能物理研究所
基于粒子流算法的电磁量能器性能研究 (2016)	面上基金	王志刚	高能物理研究所
基于THGEM探测器的数字量能器的研究(2015)	面上基金	俞伯祥	高能物理研究所
高粒度量能器上的通用粒子流算法开发(2016)	面上基金	阮曼奇	高能物理研究所
正离子反馈连续抑制型气体探测器的实验研究 (2016)	面上基金	祁辉荣	高能物理研究所
CEPC对撞区最终聚焦系统的设计研究(2015)	青年基金	王逗	高能物理研究所
利用耗尽型CPS提高顶点探测器空间分辨精度的研究 (2016)	青年基金	周扬	高能物理研究所
关于CEPC动力学孔径研究(2016)	青年基金	王毅伟	高能物理研究所

IHEP

Ministry of Sciences and Technology

2016: 36 M CNY

国家重点研发计划
项目申报书

项目名称： 高能环形正负电子对撞机相关的物理和关键技术研究
所属专项： 大科学装置前沿研究
指南方向： 高能环形正负电子对撞机预先研究
专业机构： 科学技术部高技术研究发展中心
推荐单位： 教育部
申报单位： 清华大学 （公章）
项目负责人： 高原宁

中华人民共和国科学技术部
2016 年 05 月 06 日

2018: ~31 M CNY

国家重点研发计划
项目申报书

项目名称： 高能环形正负电子对撞机关键技术研发和验证
所属专项： 大科学装置前沿研究
指南方向： 3.1 高能环形正负电子对撞机关键技术验证
专业机构： 科学技术部高技术研究发展中心
推荐单位： 中国科学院
申报单位： 中国科学院高能物理研究所 （公章）
项目负责人： Joao Guimaraes da Costa

中华人民共和国科学技术部
2018 年 02 月 26 日

~60 M CNY CAS-Beijing fund, talent program
~500 M CNY Beijing fund (light source)

Thanks to many different funding sources, CEPC team can carry out CEPC design, key-technology research and site feasibility studies

Current CEPC Organization

Since Sept. 2013

Institutional Board
YN GAO
J. GAO

Steering Committee
Y.F. WANG (IHEP),….

Project Director
XC LOU
Q. QIN
N. XU

Theory
HJ HE(TH)
JP MA(ITP)
XG HE(SJTU)

Accelerator
J. GAO (IHEP)
CY Long (IHEP)
SN FU (IHEP)

Detector
Joao Costa (IHEP)
S. JIN (NJU)
YN GAO (TH)

International Advisory Committee

Young-Kee Kim, U. Chicago (Chair)
Barry Barish, Caltech
Hesheng Chen, IHEP
Michael Davier, LAL
Brian Foster, Oxford
Rohini Godbole, CHEP, Indian Institute of Science
David Gross, UC Santa Barbara
George Hou, Taiwan U.
Peter Jenni, CERN
Eugene Levichev, BINP
Lucie Linssen, CERN
Joe Lykken, Fermilab
Luciano Maiani, Sapienza University of Rome
Michelangelo Mangano, CERN
Hitoshi Murayama, UC Berkeley/IPMU
Katsunobu Oide, KEK
Robert Palmer, BNL
John Seeman, SLAC
Ian Shipsey, Oxford
Steinar Stapnes, CERN
Geoffrey Taylor, U. Melbourne
Henry Tye, IAS, HKUST
Yifang Wang, IHEP
Harry Weerts, ANL

CEPC meetings and international impact

Many international events have been hosted to discuss CEPC physics and carry out collaboration on key-technology research

Final remarks

The CEPC Physics Program is broad and exciting

- The accelerator CDR has been completed satisfying the luminosity requirements both as a Higgs and Z factory
  - Detector CDR will follow soon
- Key technologies are under R&D and put to prototyping:
  - Accelerator: SC cavity, high efficiency klystron, low field precision magnet, copper vacuum chamber, HTS, …
  - Detector: Pixel detector, TPC, PFA-based electromagnetic and hadronic calorimeters, magnet, …
- CEPC civil engineering design and site selection going well
- CEPC funding adequate for required R&D program
- CEPC interest abroad is steadily increasing
- From 2018-2022, CEPC TDR will be finished with accelerator key hardware R&D completed and industrialization ready for construction start in 2022

Thank you for the attention!