CEPC-SppC Updates

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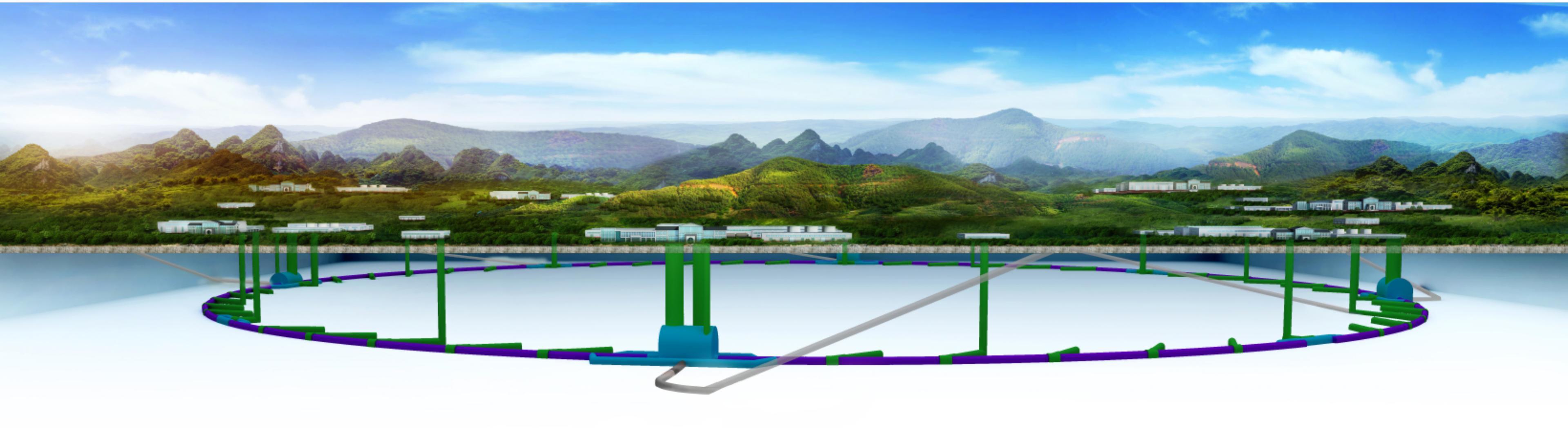
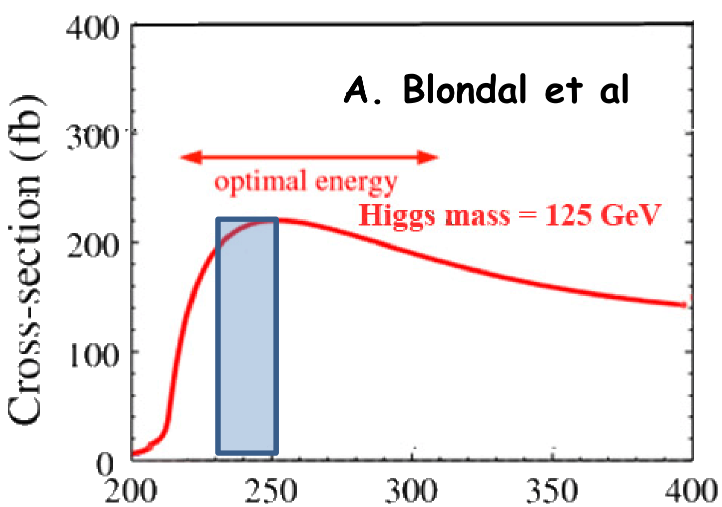
IHEP

Nov. 08, 2017



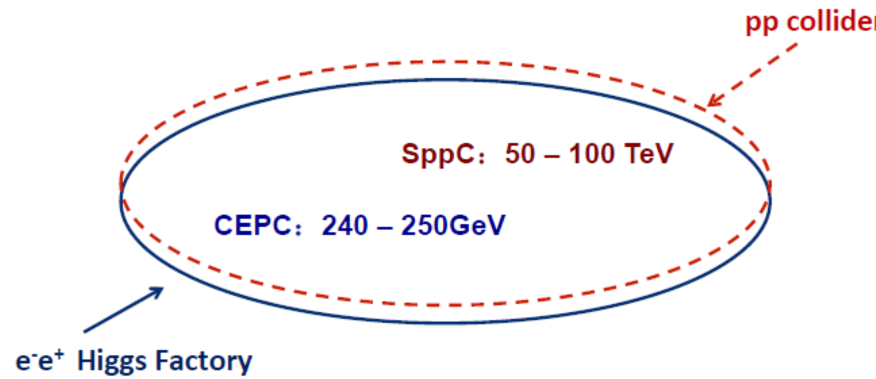
CEPC-SppC outline

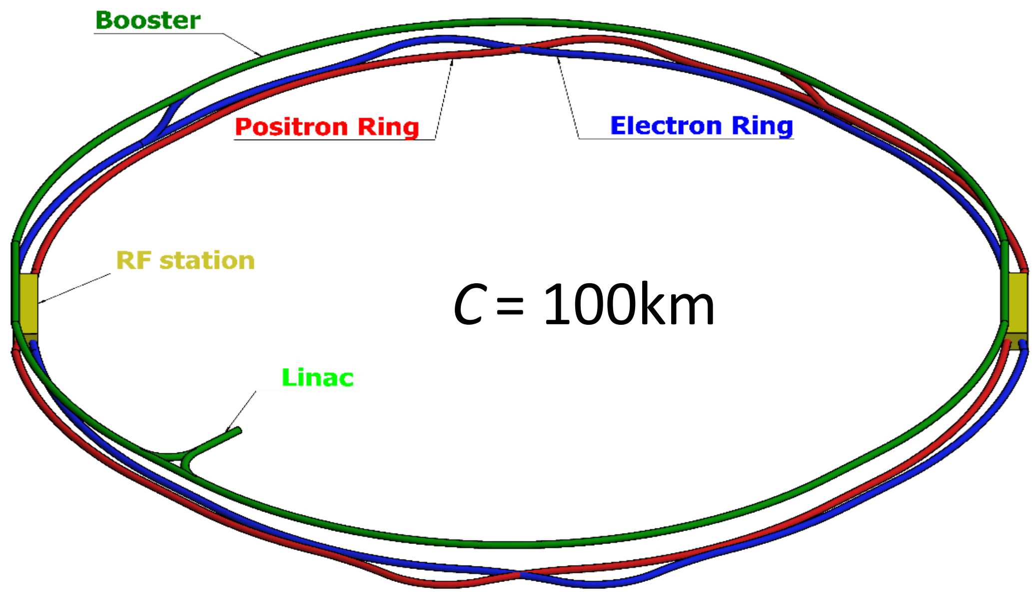
- E_b=120GeV for CEPC
  - Limited by beamstrahlung & SR (~125GeV)



- $E_{b,max}$=100TeV for SppC
  - Limited by dipole field & C

- A CEPC (phase I) + SppC (phase II) was proposed in IHEP, Sept. 2012





Physics goals of CEPC-SppC

e^+e^- Higgs & Z factory

$E_{cm} \approx$ 240GeV, luminosity >$2\times10^{34}cm^{-2}s^{-1}$, 2 IPs, 1M Higgs in 10 years

$E_{cm} \approx$ 91GeV, luminosity >$1\times10^{34}cm^{-2}s^{-1}$, 2 IPs, 10^{10} Z /year

Precision measurement of the Higgs boson and the Z boson

Upgradable to pp collision with $E_{cm} \approx$ 50-100 TeV (with ep, HI options**) in the tunnel of CEPC**

A discovery machine for BSM new physics

BEPCII will likely complete its mission ~2020s;

CEPC – possible accelerator based particle physics program in China after BEPCII

Precision measurement + Discovery:

Complementary with each other !

CEPC-SPPC Timeline (preliminary and ideal)

CEPC

2015 | 2020 | 2025 | 2030 | 2035

- Pre-studies (2013-2015)
- R&D Engineering Design (2016-2022)
- Construction (2022-2028)
- Data taking (2028-2038)

1st Milestone: Pre-CDR (by the end of 2014) ;
2nd Milestone: R&D funding from MOST (in Mid 2016);
3rd Milestone: CEPC CDR Status Report (by the end of 2016);
4th Milestone: CEPC CDR Report (by the end of 2017);
5th Milestone: CEPC TDR Report and Proto R&D (by the end of 2020);
6th Milestone: CEPC construction start (2022);

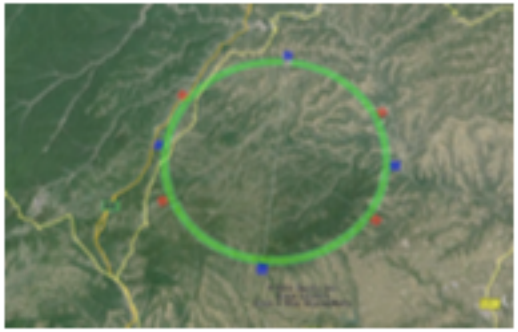
SPPC

2020 | 2030 | 2040

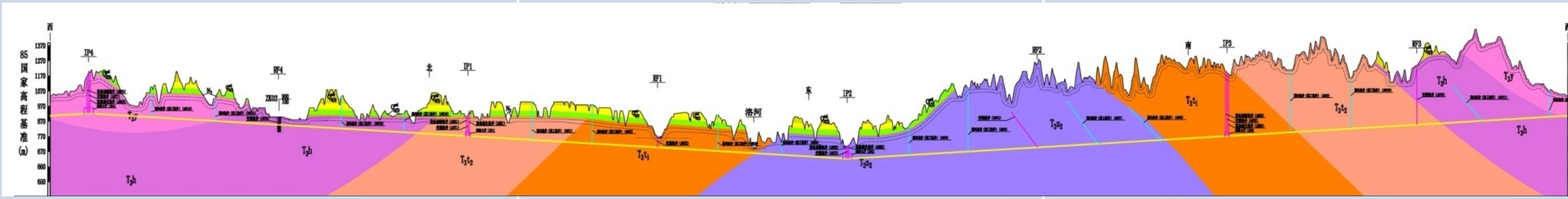
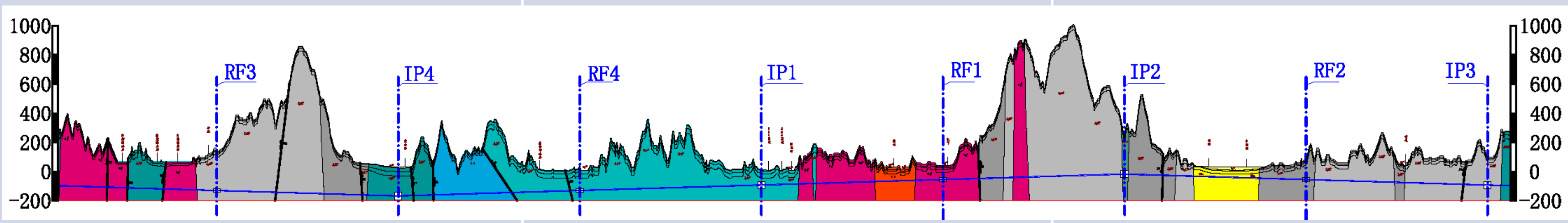
- R&D and CDR (2014-2030)
- Engineering Design (2030-2035)
- Construction (2038-2045)
- Data taking (2045-2060)

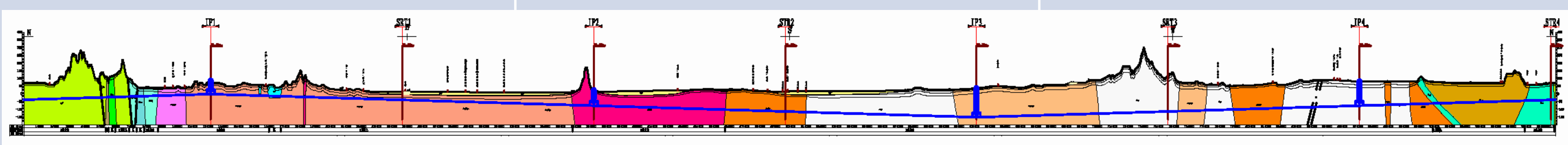
中国科学院高能物理研究所
Institute of High Energy Physics

Candidate site of CEPC-SppC



1. QingHuangDao, Hebei（completed preCDR）
2. Huangling, Shaanxi（2017.1 signed contract to exp.）
3. ShenShan, Guangdong, （completed in August, 2016)
4. …

<table>
<tr><th></th><th>Huangling</th><th>Shen-Shan</th><th>Funing</th></tr>
<tr><td>Project layout</td><td colspan="3">Huangling（100km）

Shen-Shan（100km）


Funing（100km）
</td></tr>
<tr><td>Construction difficulty</td><td>Moderate</td><td>Relatively difficult</td><td>Relatively easy</td></tr>
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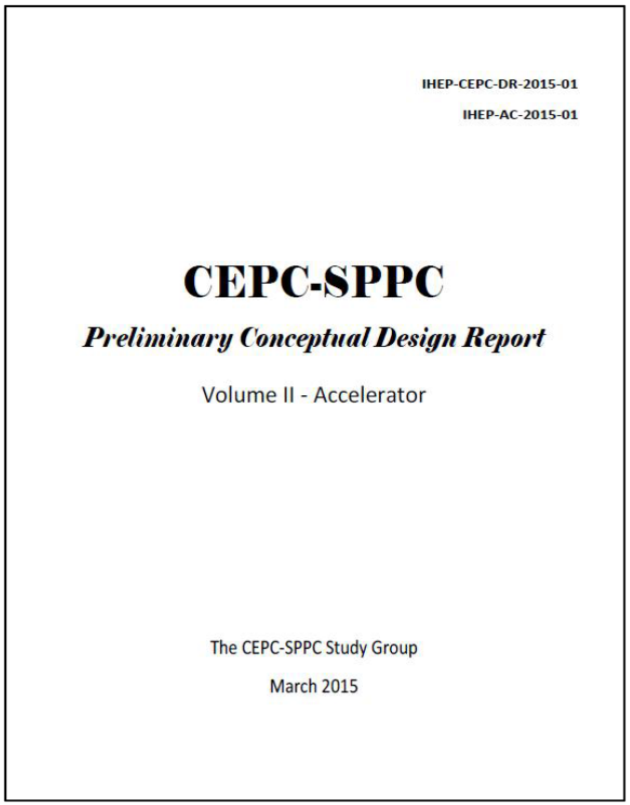
Progress report, along with the preCDR, is available at

http://cepc.ihep.ac.cn



IHEP-CEPC-DR-2015-01

IHEP-AC-2015-01

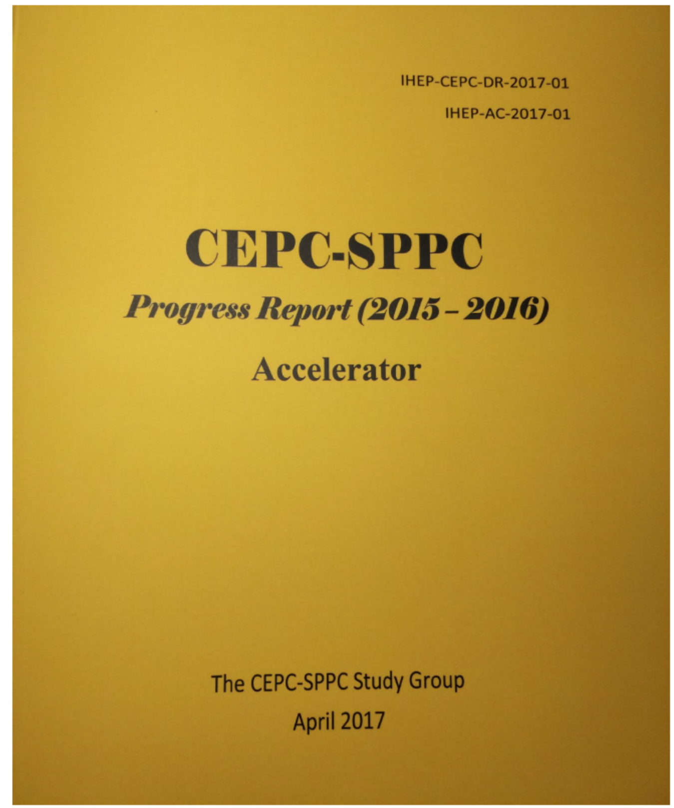
CEPC-SPPC

Preliminary Conceptual Design Report

Volume II - Accelerator

The CEPC-SPPC Study Group

March 2015



IHEP-CEPC-DR-2017-01

IHEP-AC-2017-01

CEPC-SPPC

Progress Report (2015 – 2016)

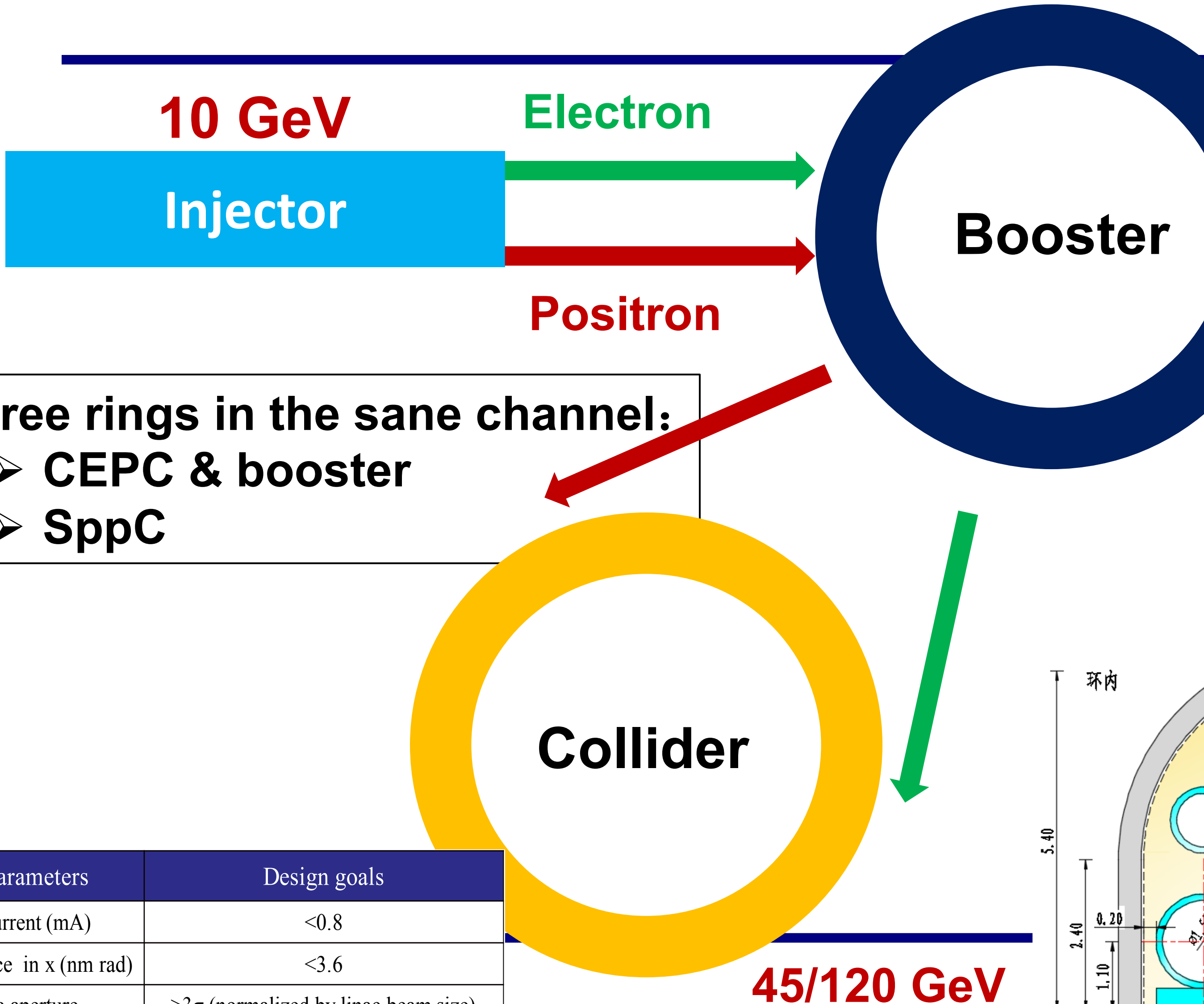
Accelerator

The CEPC-SPPC Study Group

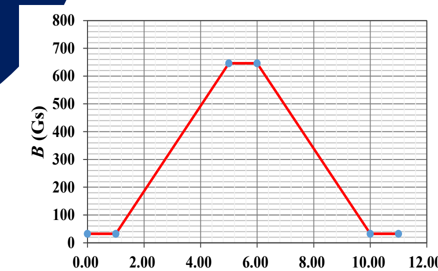
April 2017

CEPC CDR will be completed at the end of 2017

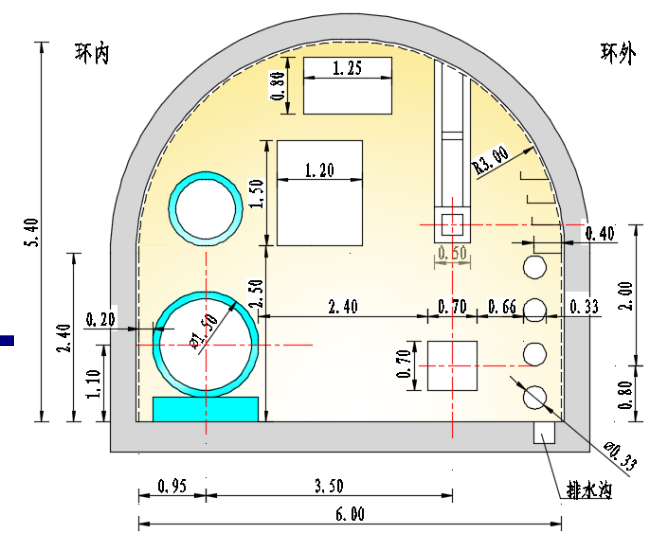
CEPC accelerator design



Three rings in the sane channel:
- CEPC & booster
- SppC

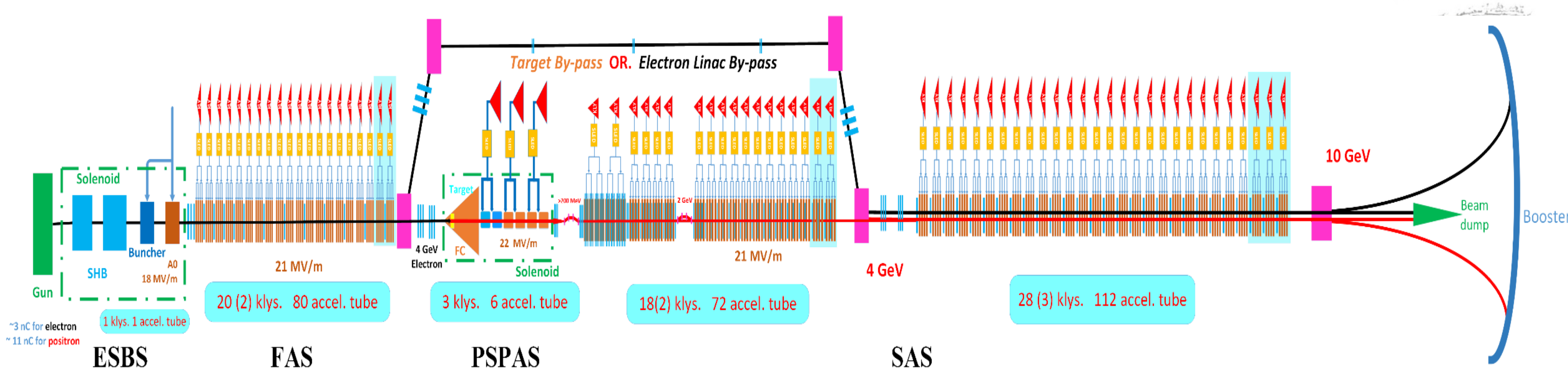


Booster Cycle (0.1 Hz)



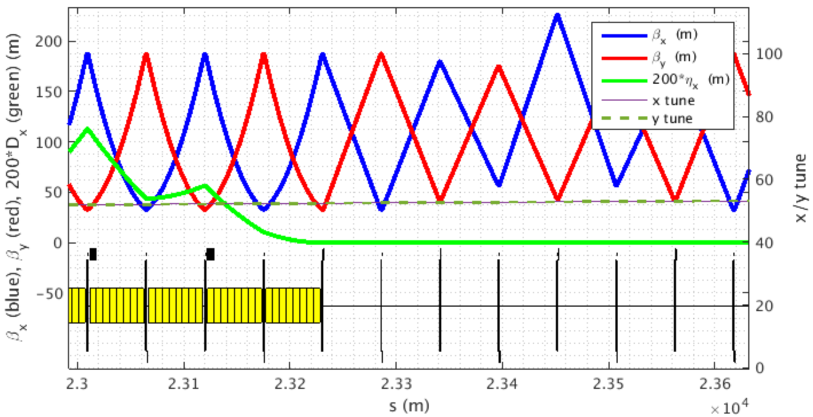
Parameters	Design goals
Beam current (mA)	<0.8
Emittance in x (nm rad)	<3.6
Dynamic aperture	>3σ (normalized by linac beam size)
Energy acceptance	>1%
Timing	Meet the top-up injection requirements

Injector linac (base-line design)

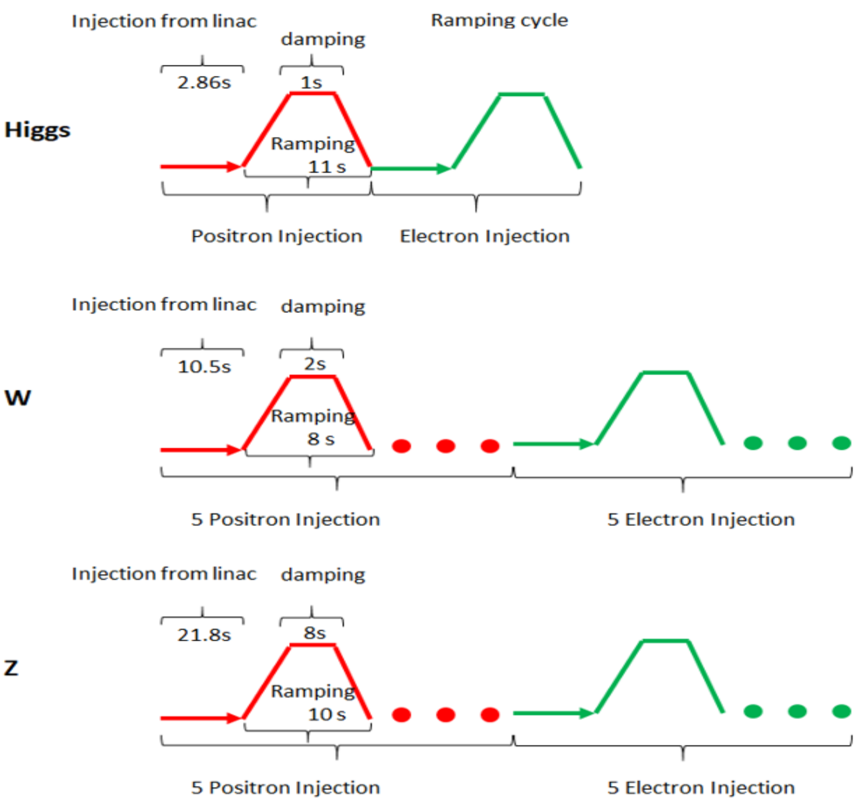


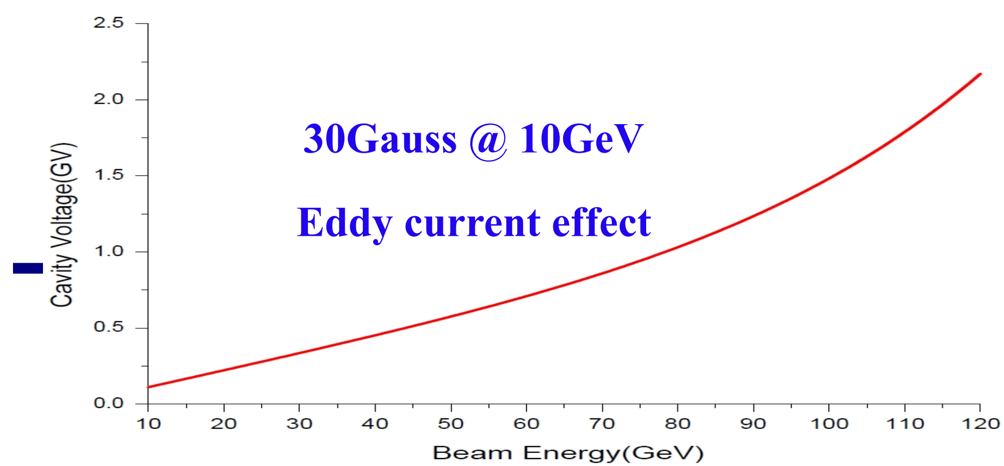
Parameter	Symbol	Unit	Goal	Status
e^-/e^+ beam energy	E_{e-}/E_{e+}	GeV	10	10/10
Repetition rate	f_{rep}	Hz	100	100
e^-/e^+ bunch population	$Ne-/Ne+$		$>6.25\times10^{9}$	$\sim1.875\times10^{10}$ $\sim1.875\times10^{10}$
	$Ne-/Ne+$	nC	>1.0	>1.0/3.0
Energy spread (e^-/e^+)	σ_E		$<2\times10^{-3}$	1.5×10^{-3} 1.2×10^{-3}
Emittance (e^-/e^+)		mm· mrad	<0.3	0.005/0.12
e^- beam energy on Target		GeV	4	4
e^- bunch charge on Target		nC	10	10

Booster design



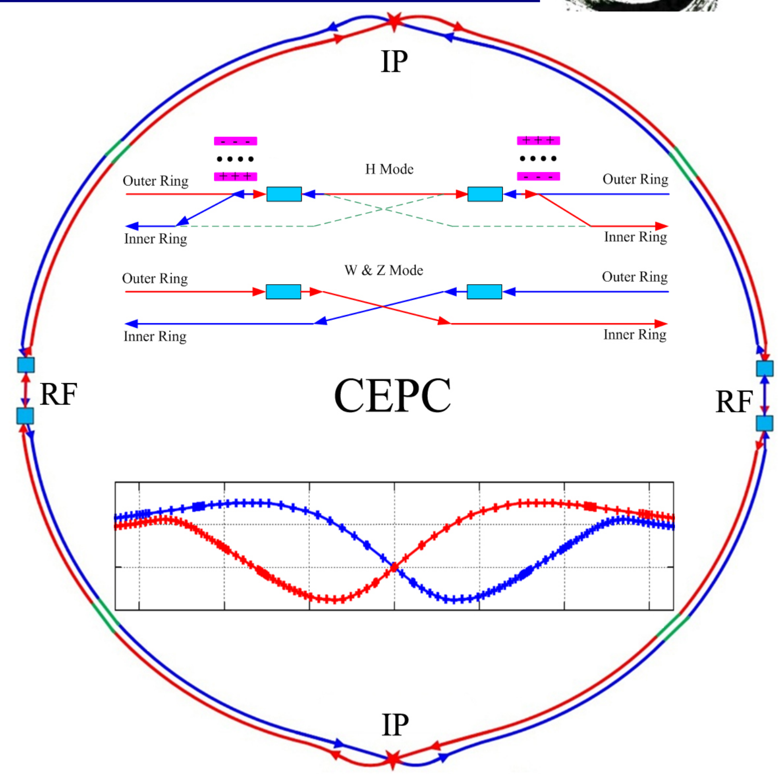
	Higgs	W	Z
Injection Energy (GeV)	120	80	45.5
Bunch number	286	1044	2180
Bunch Charge (nC)	0.62	0.173	0.077
Beam Current (mA)	**0.532**	**0.542**	**0.504**
Beam current threshold due to TMCI (mA)	**0.803**		
Number of Cycles	1	5	5
Current decay	3%	3%	3%
Ramping Cycle (sec)	10	6	2
Injection time (sec)	**28**	**185**	**318**
Collider Lifetime (hour)	0.33	3.5	7.4
Injection frequency (sec)	**37**	**383**	**811**

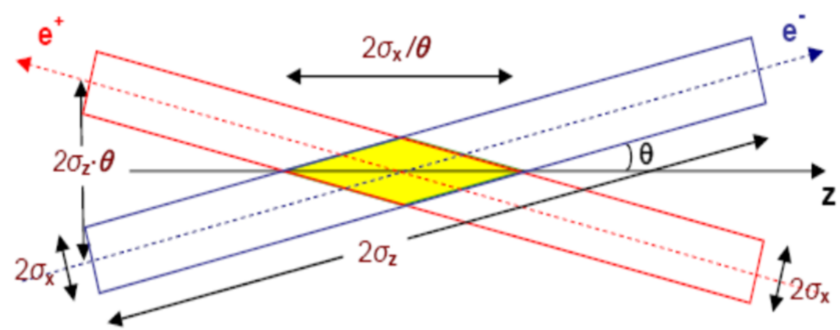




Key parameters of current CEPC ring

- 100km circumference, double ring with 2 IPs
- Matching the geometry of SPPC as much as possible
- Adopt twin-aperture quads and dipoles in the ARC
- Detector solenoid 3.0T with length of 7.6m while anti-solenoid 7.2T
- Maximum gradient of quad 151T/m (3.7T in coil)
- Tapering of magnets along the ring
- Two cell & 650MHz RF cavity
- Two dedicated surveys in the RF region for Higgs and Z modes
- Maximum e+ beam power 30MW & e- 30MW
- Crab-waist scheme with local X/Y chromaticity correction
- Common lattice for all energies.





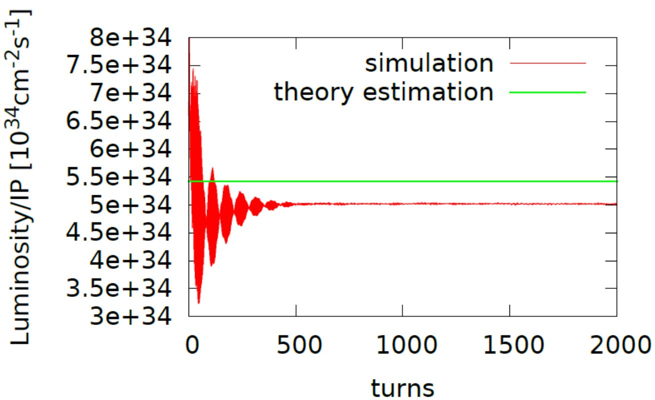
Parameters of CEPC double ring

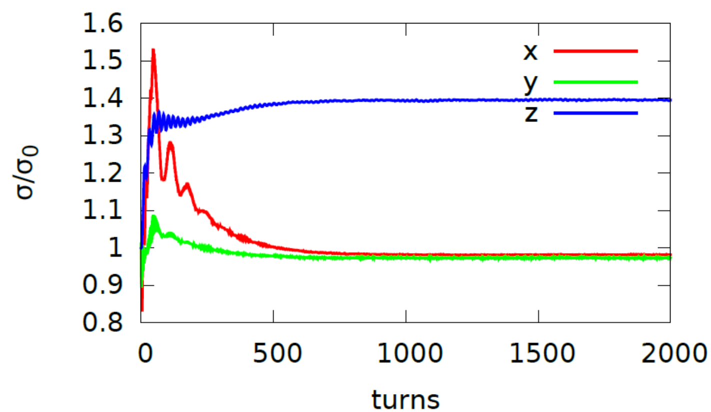
	Higgs	*W*	*Z*
Number of IPs	2		
Energy (GeV)	120	80	45.5
Circumference (km)	100		
SR loss/turn (GeV)	1.68	0.33	0.035
Half crossing angle (mrad)	16.5		
Piwinski angle	2.75	4.39	10.8
N_e/bunch (10^{10})	12.9	3.6	1.6
Bunch number	286	5220	10900
Beam current (mA)	17.7	90.3	83.8
SR power /beam (MW)	30	30	2.9
Bending radius (km)	10.9		
Momentum compaction (10^{-5})	1.14		
β_{IP} x/y (m)	0.36/0.002		
Emittance x/y (nm)	1.21/0.0036	0.54/0.0018	0.17/0.0029
Transverse σ_{IP} (um)	20.9/0.086	13.9/0.060	7.91/0.076
ξ_x/ξ_y/IP	0.024/0.094	0.009/0.055	0.005/0.0165
V_{RF} (GV)	2.14	0.465	0.053
f_{RF} (MHz) (harmonic)	650 (217500)		
Nature bunch length σ_z (mm)	2.72	2.98	3.67
Bunch length σ_z (mm)	3.48	3.7	5.18
HOM power/cavity (kw)	0.46 (2cell)	0.32(2cell)	0.11(2cell)
Energy spread (%)	0.098	0.066	0.037
Energy acceptance requirement (%)	1.21		
Energy acceptance by RF (%)	2.06	1.48	0.75
Photon number due to beamstrahlung	0.25	0.11	0.08
Lifetime due to beamstrahlung (hour)	1.0		
Lifetime (hour)	0.33 (20 min)	3.5	7.4
F (hour glass)	0.93	0.96	0.986
L_{max}/IP ($10^{34}cm^{-2}s^{-1}$)	2.0	4.1	1.0

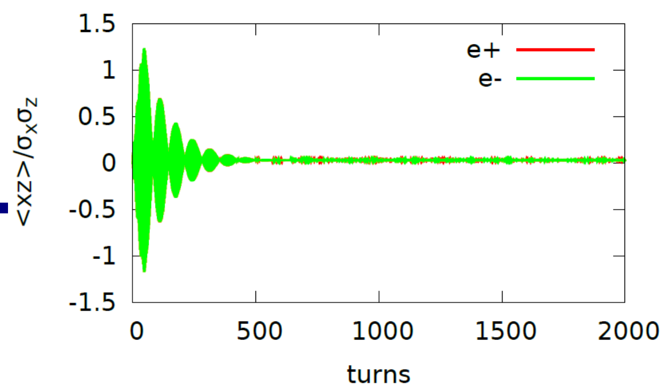
Accelerator physics study

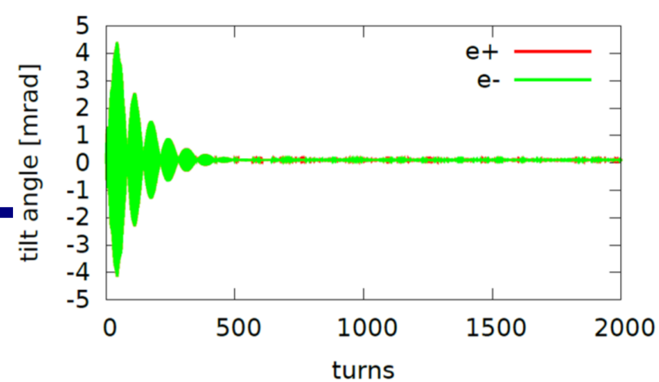
Beam-beam simulation with strong-strong model

- With full crab waist, Higgs energy, beta_y = 1mm, Lifetime: 400min
- Working point: (0.54, 0.61) with ν_s = 0.0272
- In Phase <xz> oscillation in the first few hundred collisions

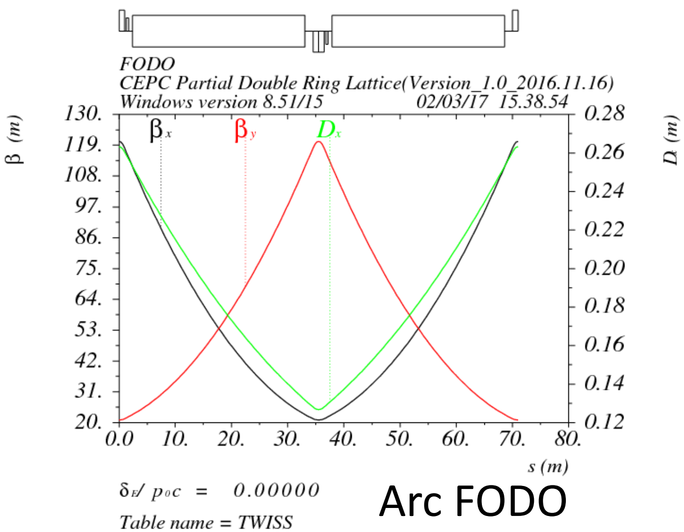




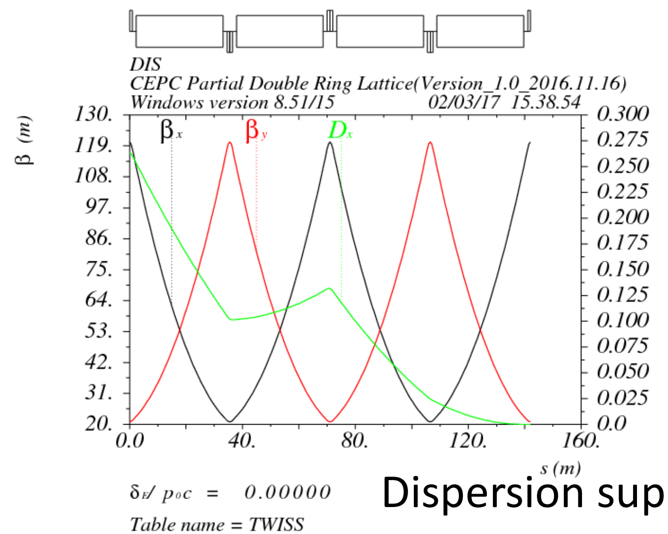




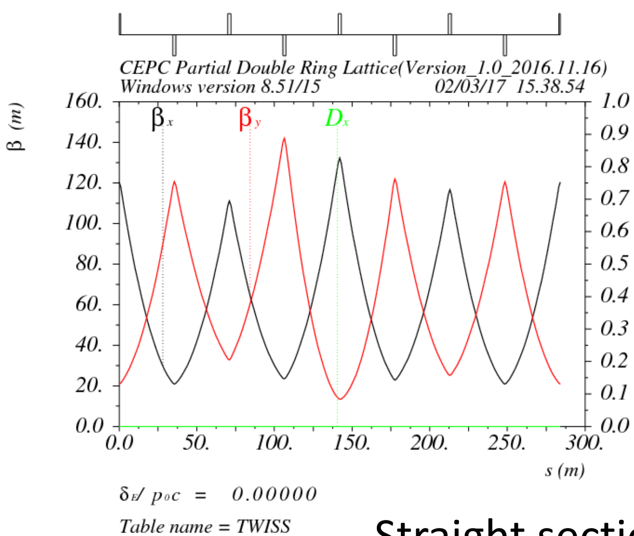
Linear lattice design



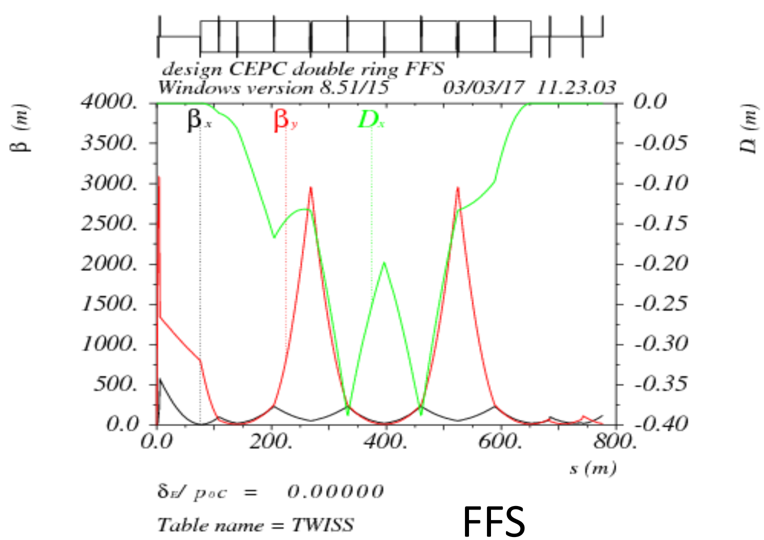
Arc FODO



Dispersion suppressor



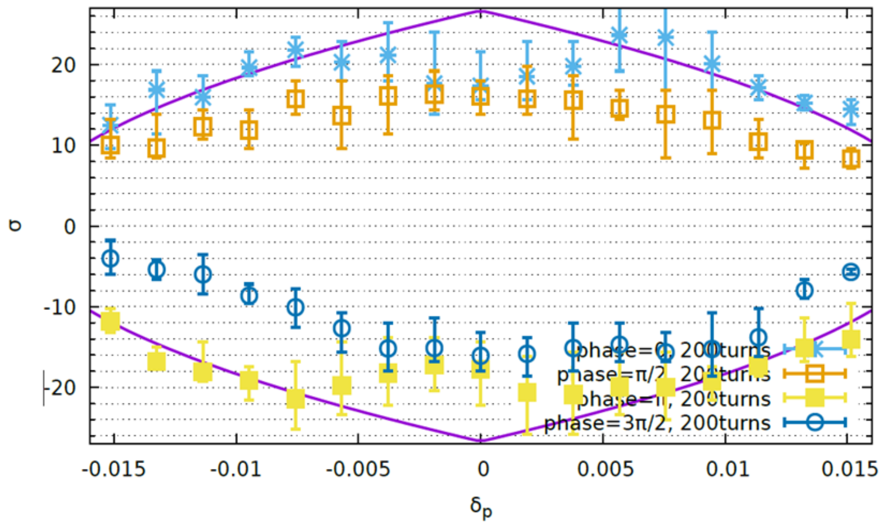
Straight section



FFS

Dynamic aperture study

- **DA requirement for Higgs** (with errors, crab sextupoles and beam-beam)
  - On-momentum: $20\sigma_x \times 40\sigma_y$
  - Energy acceptance: 1.1%
- Multi-sextupole optimization
  - Two methods:
    - Downhill Simplex
    - MODE (**M**ulti-**O**bjective optimization by **D**ifferential **E**volution)
  - Effects included in DA tracking
    - Synchrotron oscillation
    - Damping + quantum excitation
    - Sawtooth + tampering

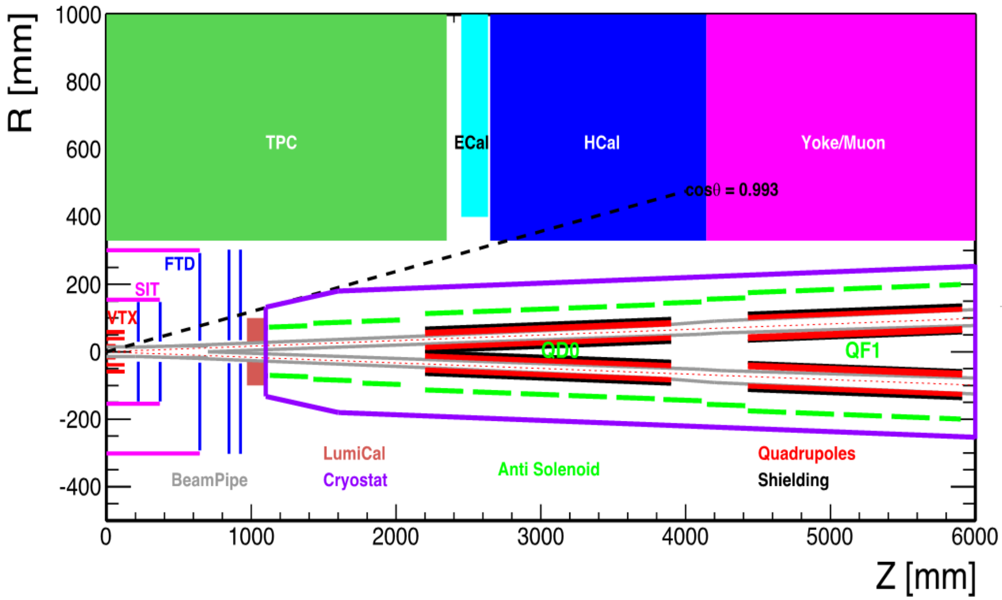


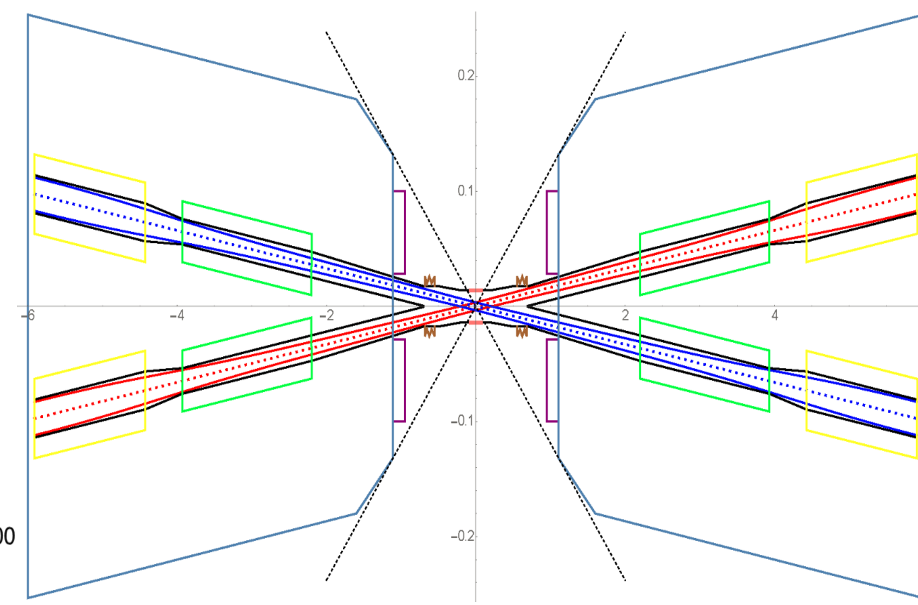
- DA still the bottleneck of CEPC accelerator design
- Plans for improvement
  - Increase βx^* → reduce nonlinearity and requirement for DA bandwidth
  - Lengthen quadrupole → reduce fluctuation effect

IR design

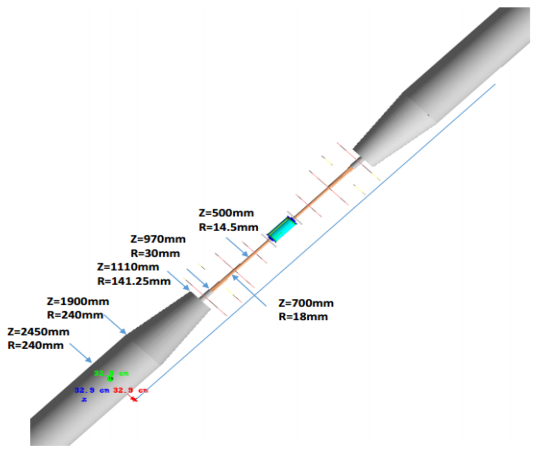
✓ **L*=2.2m, θc=33mrad, βx*=0.36m, Detector solenoid=3.0T**

- Lower strength requirements of anti-solenoids (~7.2T)
- Enough space for the SC quadrupole coils in two-in-one type (Peak field 3.7T & 151T/m) with room temperature vacuum chamber
- The control of SR power from the superconducting quadrupoles.

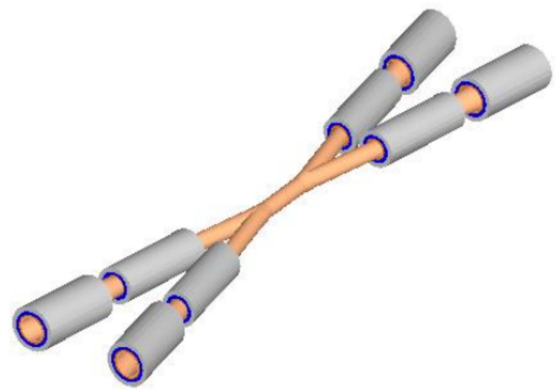


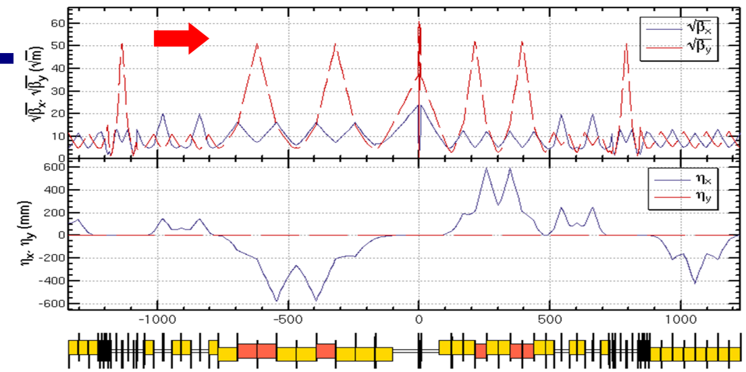


IR design

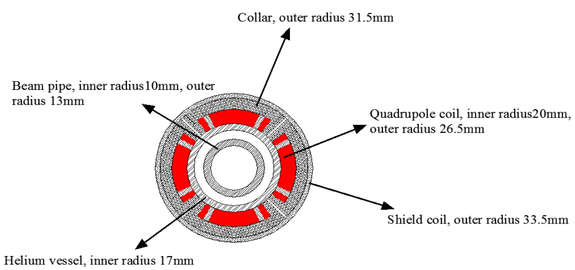


Z=500mm
R=14.5mm
Z=970mm
R=30mm
Z=1110mm
R=141.25mm
Z=1900mm
R=240mm
Z=2450mm
R=240mm
Z=700mm
R=18mm

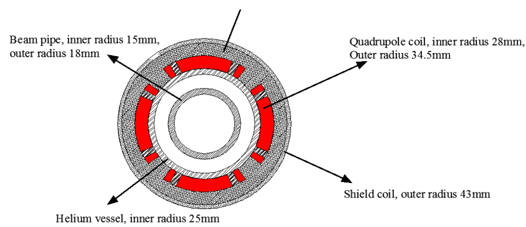




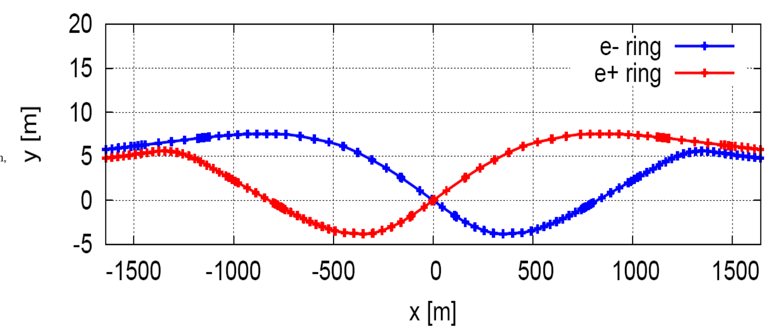
$\sqrt{\beta_x}$
$\sqrt{\beta_y}$
$\sqrt{\beta_x}, \sqrt{\beta_y}$ ($\sqrt{m}$)
η_x
η_y
η_x, η_y (mm)
-1000
-500
0
500
1000



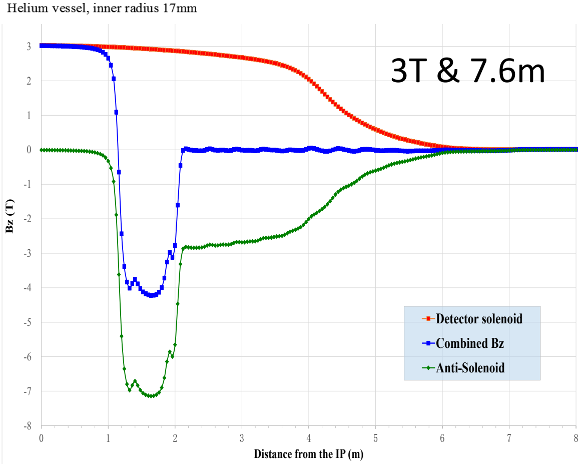
Collar, outer radius 31.5mm
Beam pipe, inner radius10mm, outer radius 13mm
Quadrupole coil, inner radius20mm, outer radius 26.5mm
Shield coil, outer radius 33.5mm
Helium vessel, inner radius 17mm



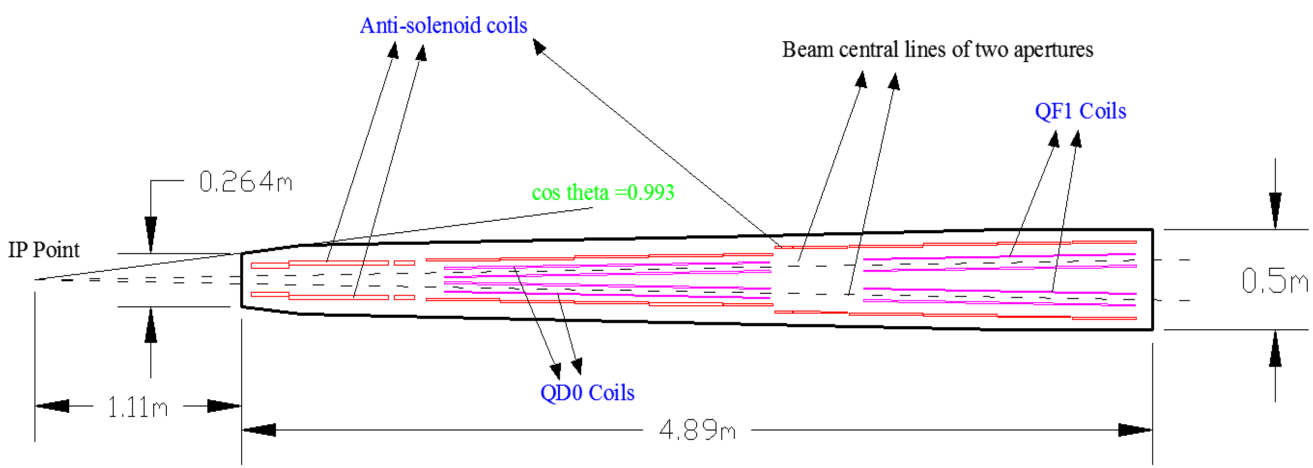
Beam pipe, inner radius 15mm, outer radius 18mm
Quadrupole coil, inner radius 28mm, Outer radius 34.5mm
Shield coil, outer radius 43mm
Helium vessel, inner radius 25mm



e- ring
e+ ring
y [m]
x [m]



3T & 7.6m
Bz (T)
Distance from the IP (m)
Detector solenoid
Combined Bz
Anti-Solenoid

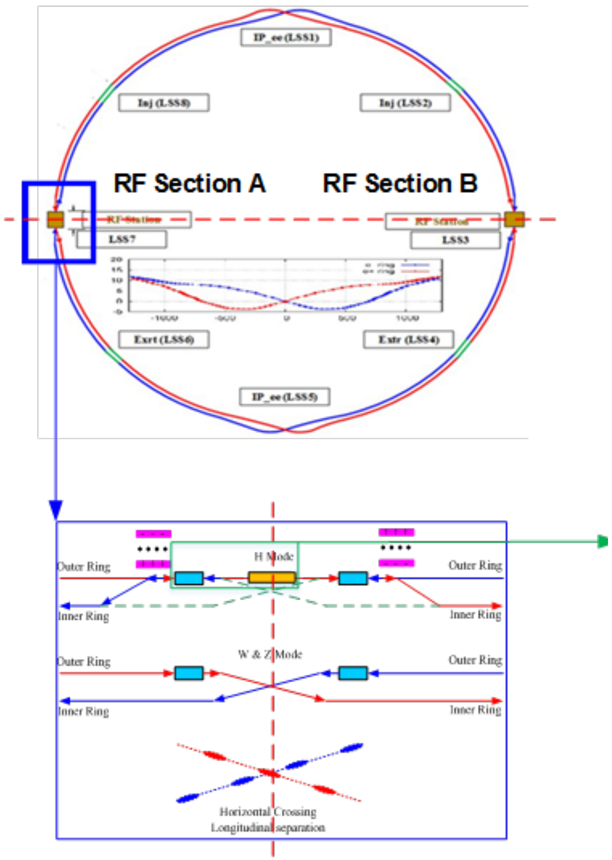


Anti-solenoid coils
Beam central lines of two apertures
QF1 Coils
0.264m
cos theta =0.993
IP Point
0.5m
QD0 Coils
1.11m
4.89m

Technical system consideration

- **Key technologies**
  - Polarized electron gun
  - High current positron source
  - High Q superconducting RF cavity and high power coupler
    - Max. operation Q = $2x10^{10}$@2K
    - Max. power of high power coupler = 300kW
  - High efficiency klystron
    - ~80% as the goal for 650MHz klystron
  - Large scale cryogenics system
  - Low field dipole magnet (booster)
  - Electro-static separator for deflect two beams
  - etc.

CEPC SRF system layout

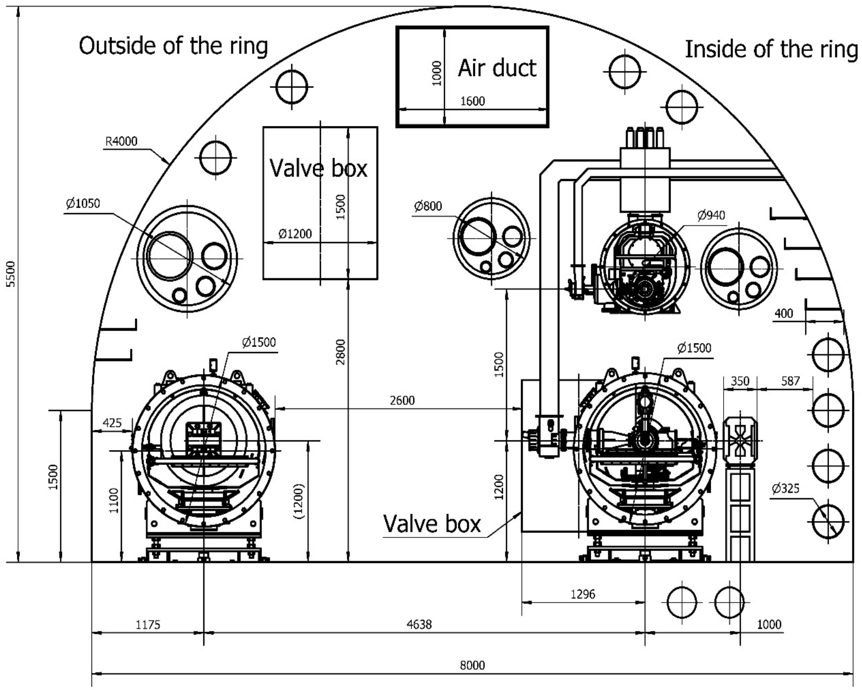


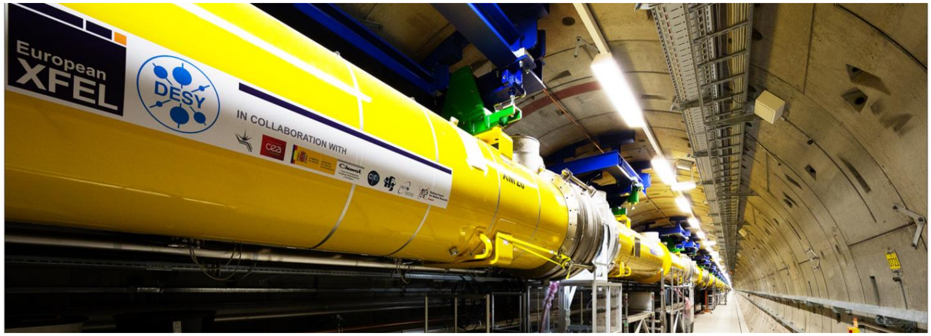
RF Section A

- Two Collider Ring RF Stations CRFA1 (84 cavities in 14 cryomodules) and CRFA2 (84 cavities in 14 cryomodules) (blue)
- One Booster RF Station BRFA (48 cavities in 6 cryomodules) (orange)
- Straight section length between CRFA1 and CRFA2: 368.6 m

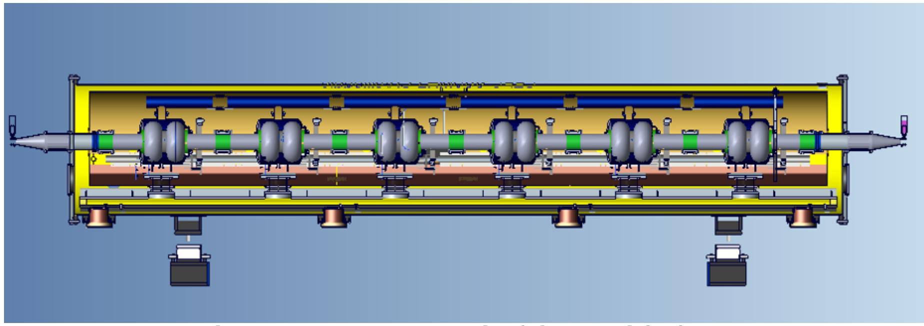
	H	W	Z
Collider Ring	**650 MHz 2-cell cavity**		
Lumi. / IP (10^{34} $cm^{-2}s^{-1}$)	2	4	1
RF voltage (GV)	2.14	0.465	0.053
Beam current (mA)	17.7 x 2	90.2	83.7
Cavity number	336	108 x 2	12 x 2
SR power (MW)	30	30	2.9
2 K cavity wall loss (kW)	6.4	1	0.1
Booster Ring (extraction)	**1.3 GHz 9-cell cavity**		
RF voltage (GV)	1.83	0.7	0.36
Beam current (mA)	0.53	0.53	0.51
Cavity number	96	64	32
RF input power (MW) avg.	0.1	0.02	0.01
2 K wall loss (kW) avg.	0.2	0.1	0.03

- Same cavities for H, W, Z and one-time full installation
- Common collider cavities for H, independent for W & Z

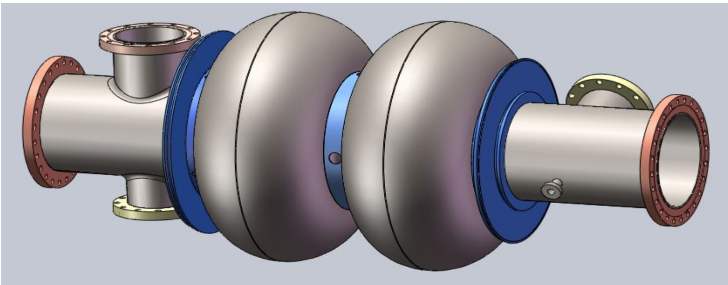


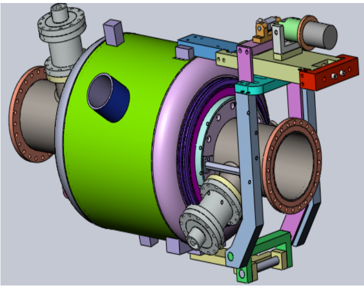


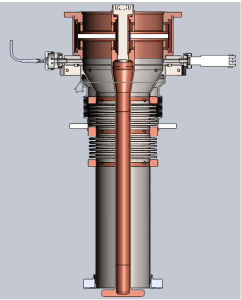
1.3 GH SRF - TESLA / XFEL / ILC / LCLS-II

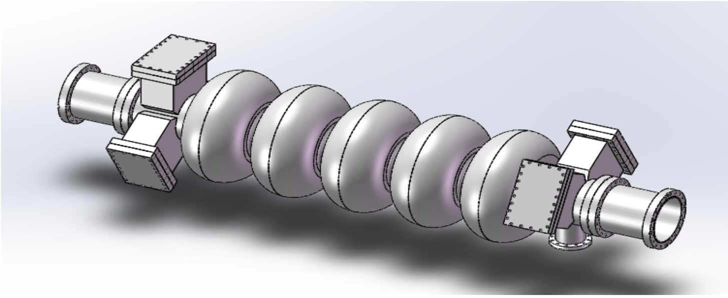


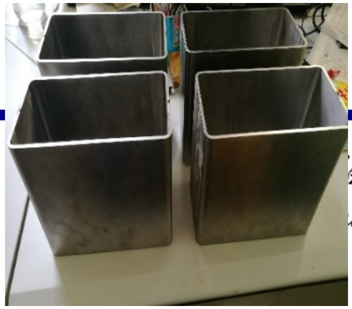
650 MHz SRF - ADANES (CADS) / PIP-II

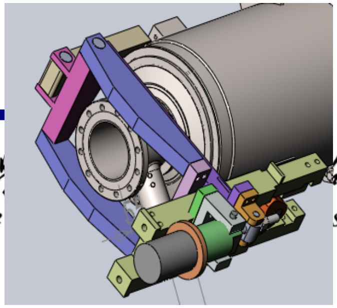




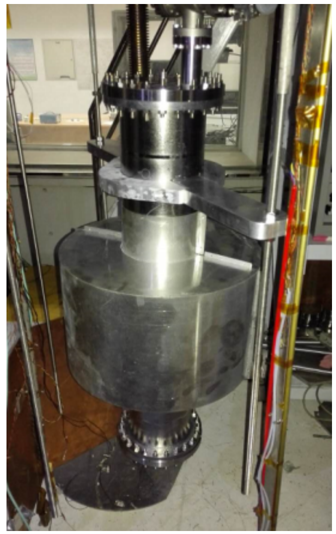


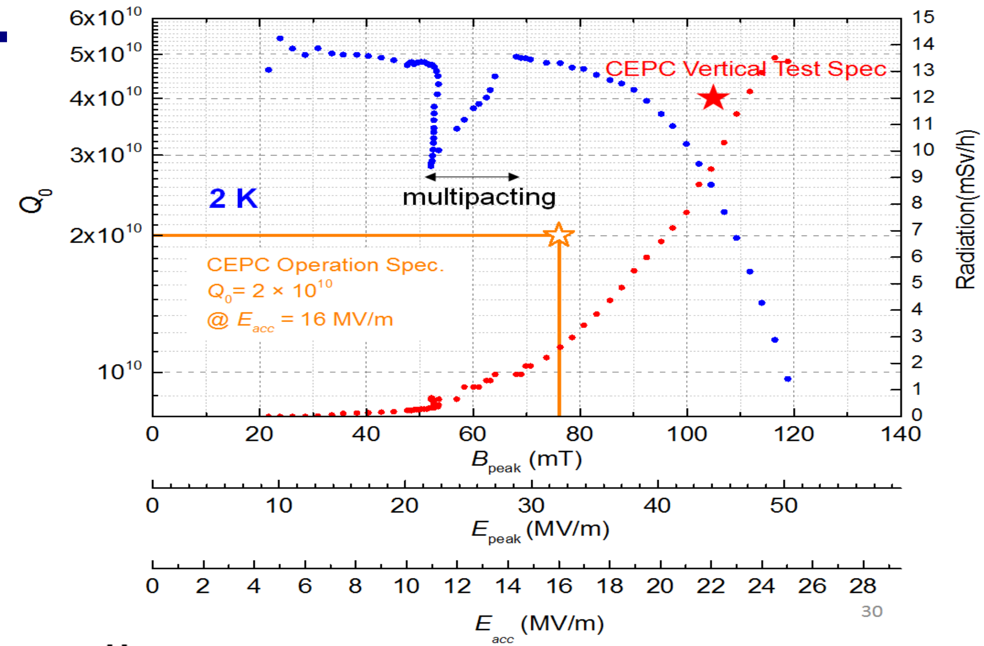




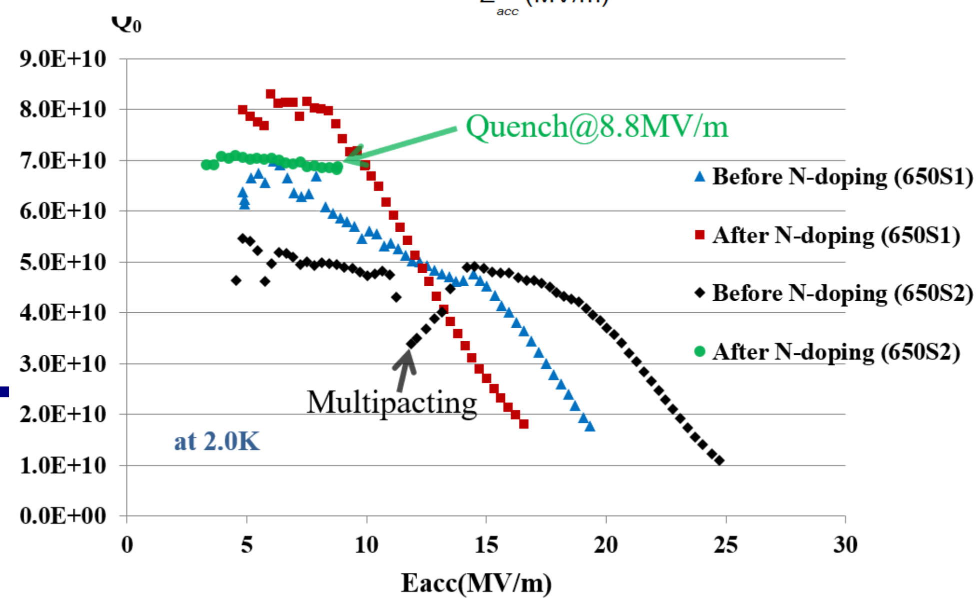


N-doping for 650MHz SC cavity



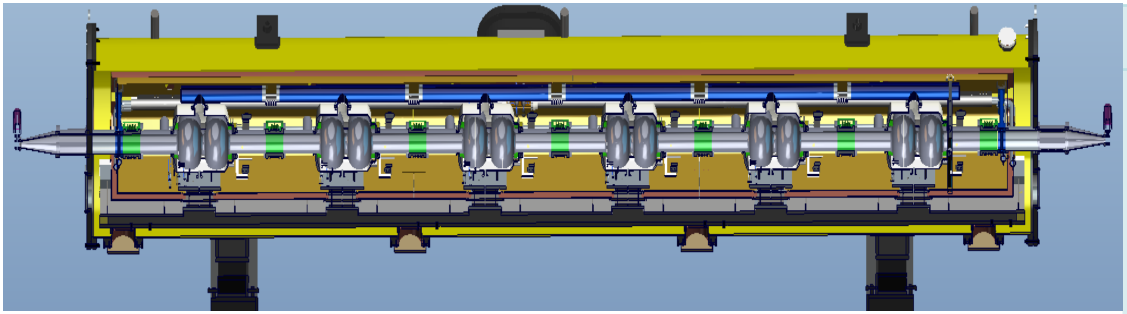


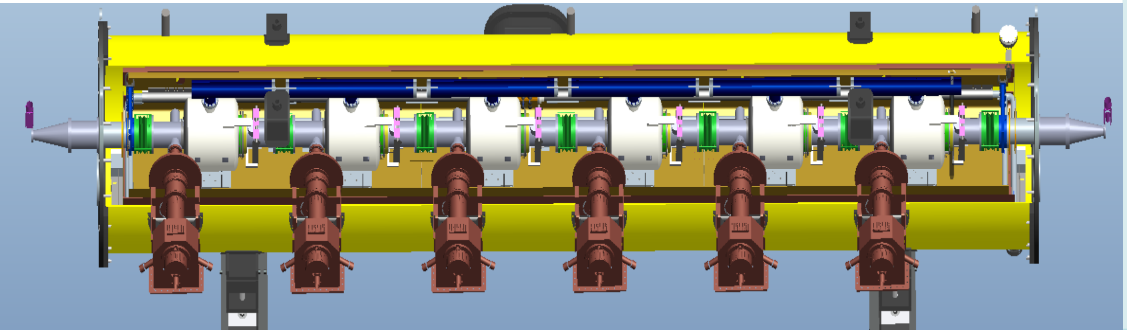
- 130um BCP + 3 h 750 C annealing + 30um BCP + 120 C bake 48 h
- Shielded dewar, remnant magnetic field 20 mG. Additional magnetic shield around cavity.



CEPC 650 MHz Cavity Cryomodule

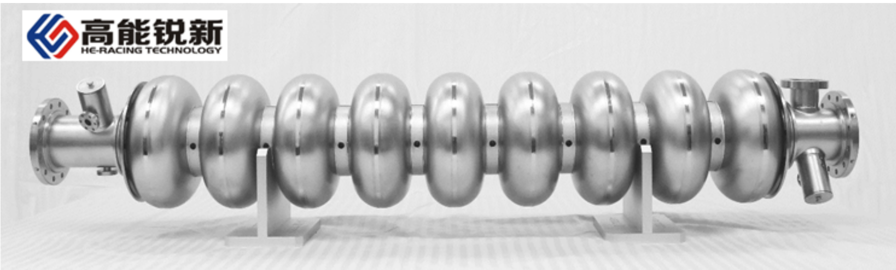
- **Structure is based on ADS cryomodule. High Q requirement drives new design features (fast cool down and magnetic hygiene).**
- **Fast cool down rate is supposed to be 10 K/min during 45 K to 4.5 K.**
- **Ambient magnetic field at cavity surface should be less than 5 mG. Magnetic shielding and demagnetization of parts and the whole module should be implemented for the magnetic hygiene control**



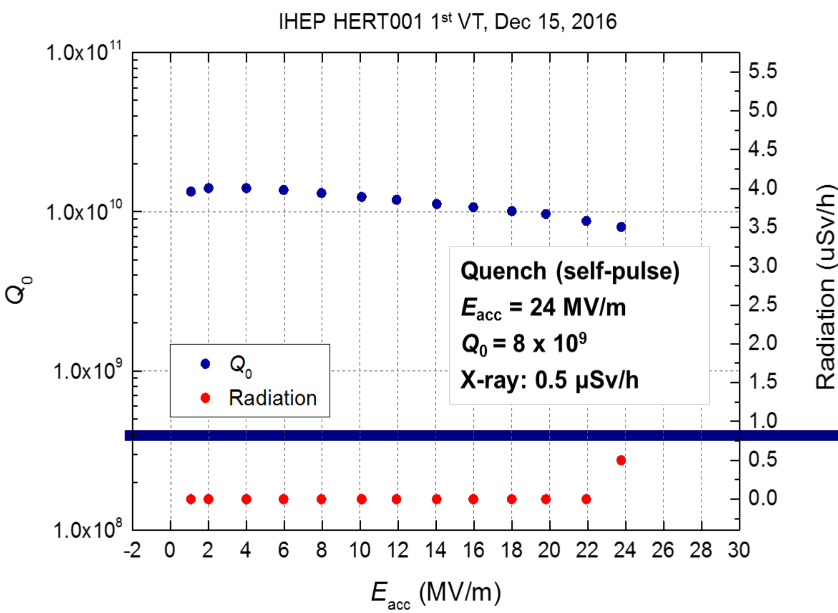


Overall length (flange to flange, m)	8.0
Diameter of vacuum vessel (m)	1.3
Beamline height from floor (m)	1.2
Cryo-system working temperature (K)	2
Number of cavities and tuners	6
Number of couplers	6
Number of RT HOM absorbers	2
Number of 200-POSTs	6
Static heat loads at 2 K (W)	5
Alignment x/y (cavities) (mm)	0.5
Alignment z (mm)	2

SRF industrialization



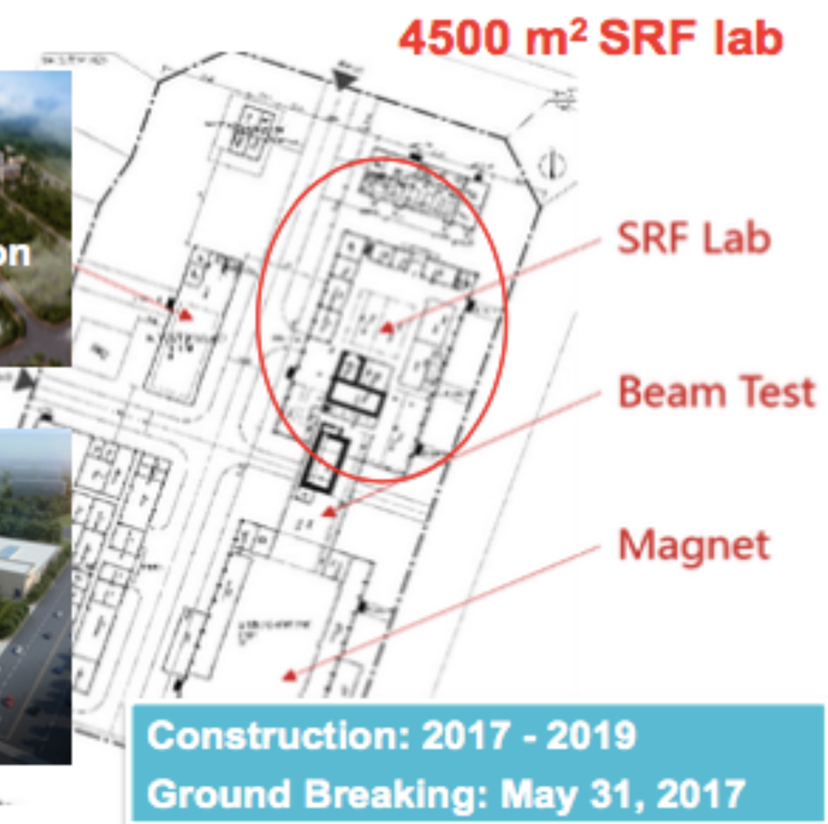
TESLA FG 9-cell cavity by HERT (new vendor). Processed and tested at KEK. Two more TESLA cavities in fabrication by HERT (material delivered). High gradient and N-doping / infusion study.



CEPC Industry Consortium

New SRF infrastructure at Huairou District, Beijing

- Platform of Advanced Photon Source tech. R&D (PAPS), supported by Beijing local government and mainly constructed for the High Energy Photon Source (HEPS), could be used for SRF development



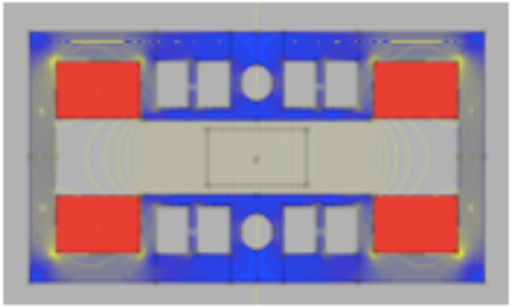
R&D on the low field dipole magnet of booster

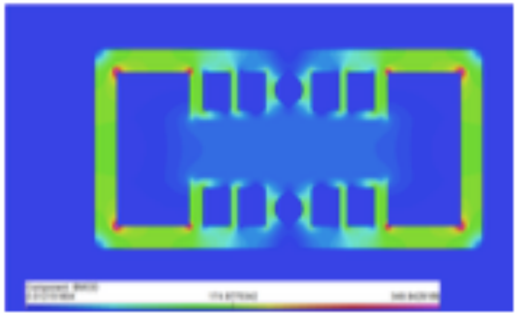
- To verify the magnet design and field simulation, a *1m* long prototype dipole magnet （booster） was developed and measured

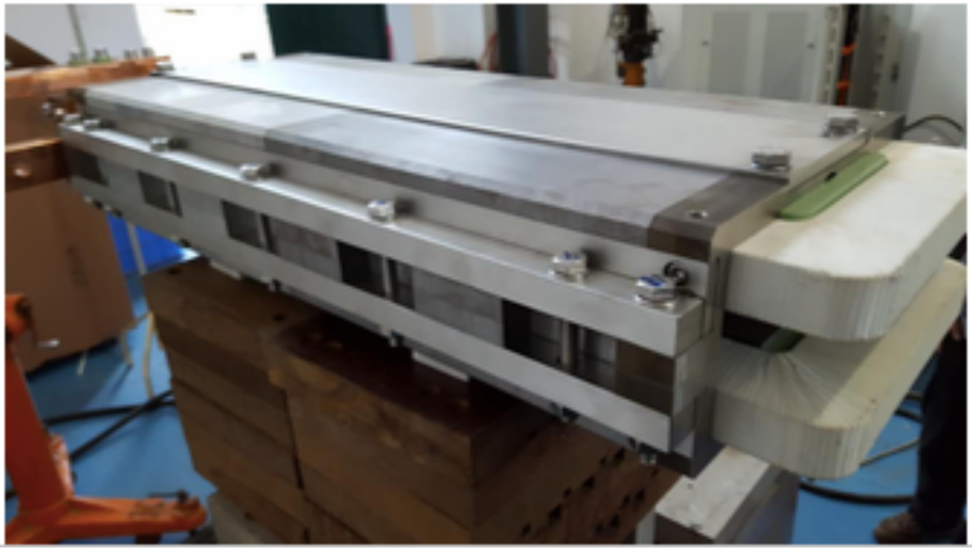
  - Supported by IHEP workshop

Specifications of the dipole magnets (from Pre-CDR)

Quantity:	5120
Magnetic length:	8m
Gap height:	40mm
Maximum field:	614Gs
Injection field:	31Gs
Repetitive frequency:	0.1Hz
Good field region:	52mm
Field uniformity:	5E-4 (0.015Gs@inj.)
Field reproducibility:	1E-3 (0.03Gs@inj.)
Linearity of excitation:	95%

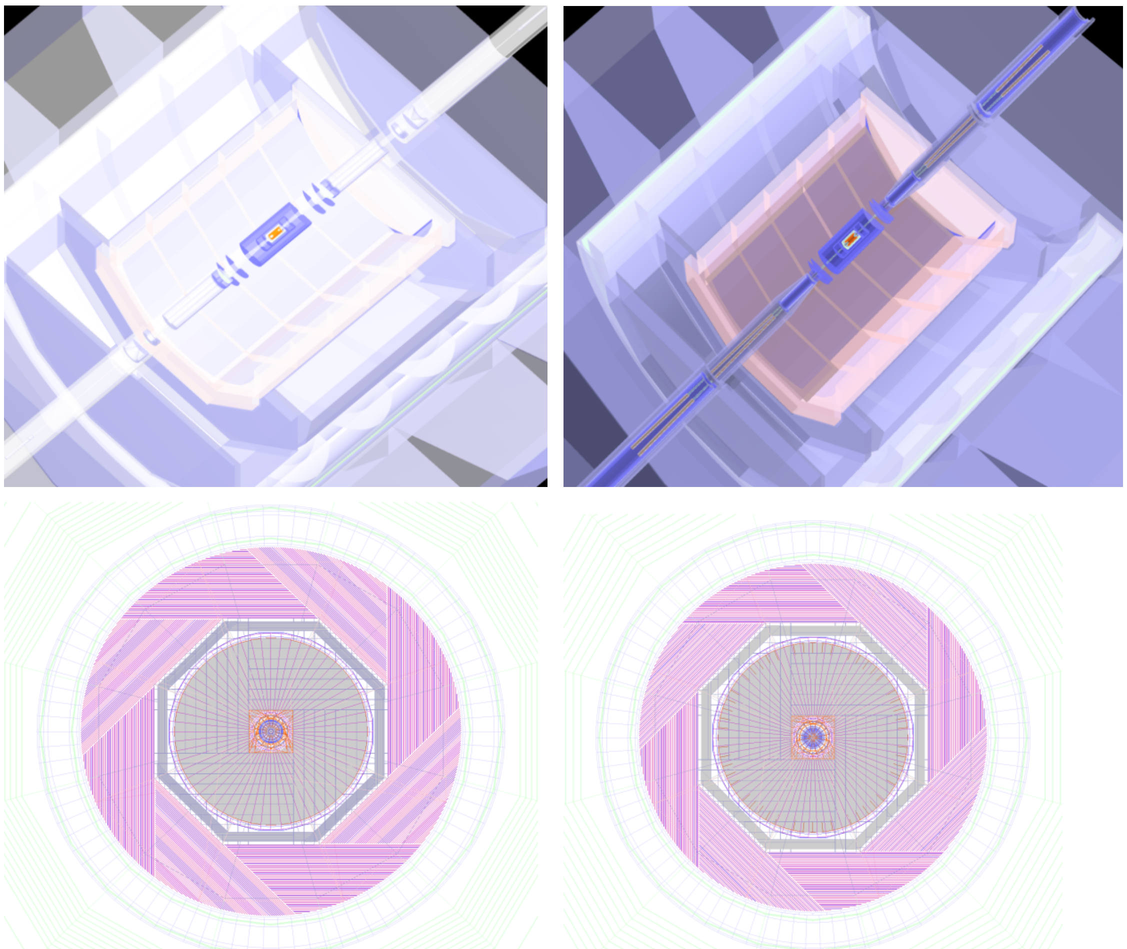


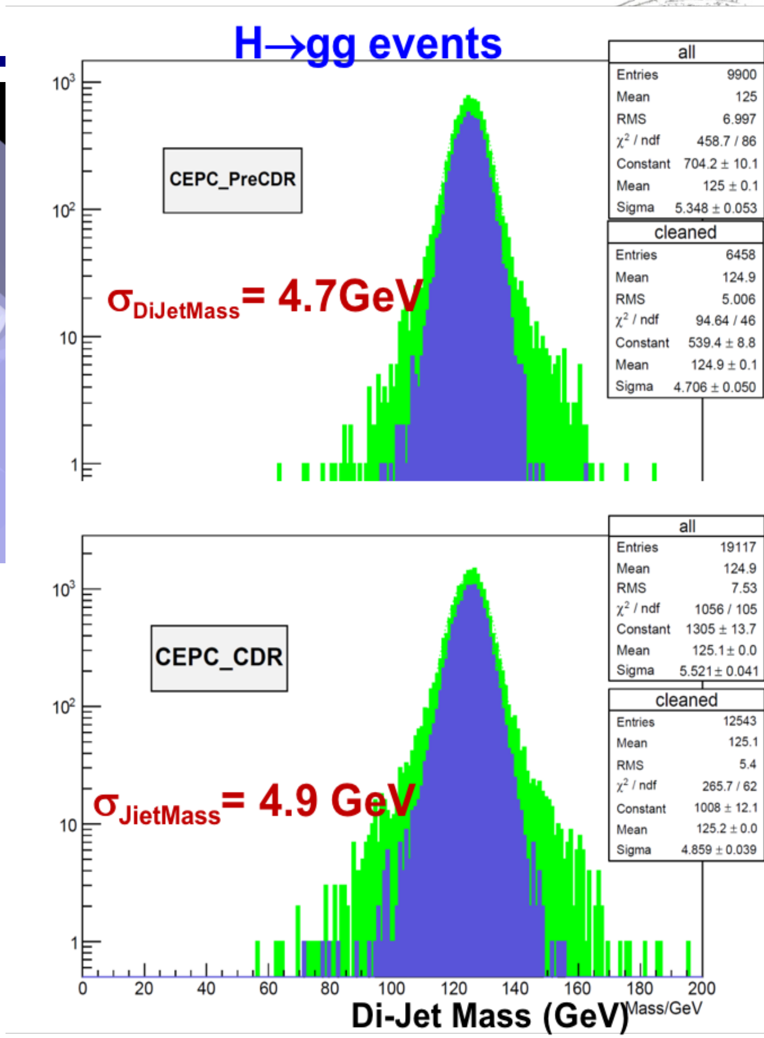




CEPC Detector: more compact & updated for CDR

preCDR (2015) → **CDR (2017)**





CDR CEPC detector:
Double ring geometry & MDI design implemented
HCAL reduced to 40 layers (from 48 in preCDR)

No visible impact on physics performance

CEPC Detector: more compact & updated for CDR

Feasibility & Optimized Parameters

Feasibility analysis: TPC and Passive Cooling Calorimeter is valid for CEPC

	CEPC_v1 (~ ILD)	Optimized (Preliminary)	Comments
Track Radius	1.8 m	>= 1.8 m	Requested by Br(H->di muon) measurement
B Field	**3.5 T**	**3 T**	**Requested by MDI**
ToF	**-**	**50 ps**	**Requested by pi-Kaon separation at Z pole**
ECAL Thickness	84 mm	84(90) mm	84 mm is optimized on Br(H->di photon) at 250 GeV;
ECAL Cell Size	5 mm	10 – 20 mm	Passive cooling request ~ 20 mm. 10 mm should be highly appreciated for EW measurements – need further evaluation
ECAL NLayer	30	20 – 30	Depends on the Silicon Sensor thickness
HCAL Thickness	**1.3 m**	**1 m**	-
HCAL NLayer	**48**	**40**	Optimized on Higgs event at 250 GeV;

From CEPC to SppC

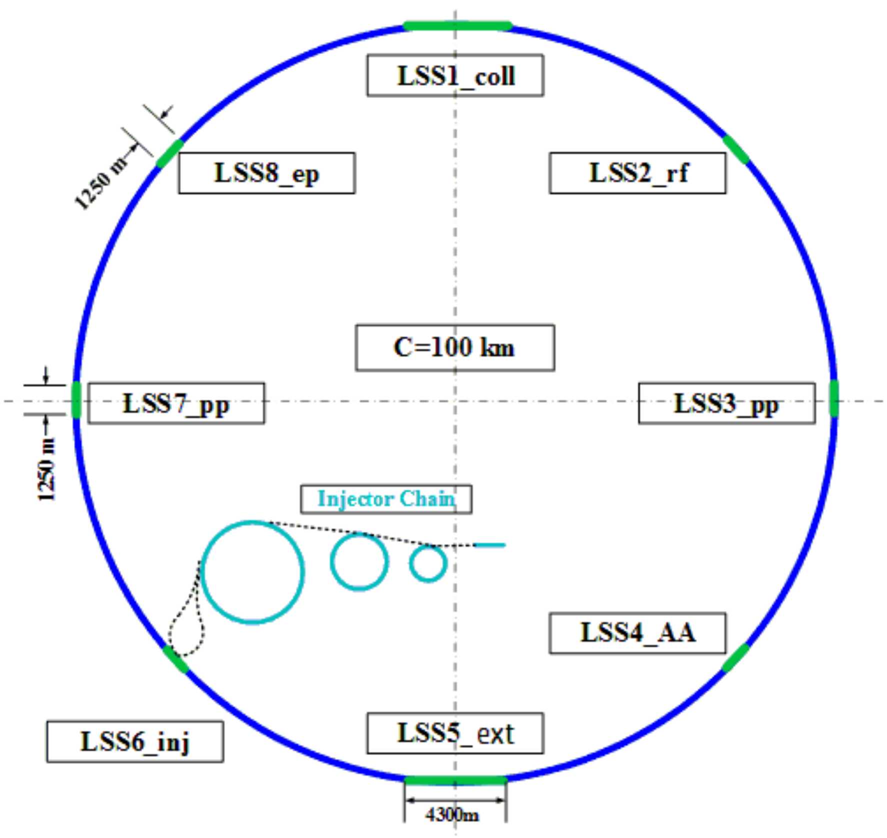
- SppC Baseline design
  - Tunnel circumference: 100 km
  - Dipole magnet field: 12 T, using full iron-based HTS technology
  - Center of Mass energy: >70 TeV
  - Injector chain: 2.1 TeV
  - Relatively lower luminosity for the first phase, higher for the second phase
- Energy upgrading phase
  - Dipole magnet field: 20 -24T, full iron-based HTS technology
  - Center of Mass energy: >125 TeV
  - Injector chain: 4.2 TeV (e.g., adding a high-energy booster ring in the main tunnel in the place of the electron ring and booster)
- Development of high-field superconducting magnet technology
  - Starting to develop required HTS magnet technology; before applicable iron-based HTS wire are available, models by YBCO and LTS wires can be used for specific studies (magnet structure, coil winding, stress, quench protection method etc.)

SPPC main parameters (updated)

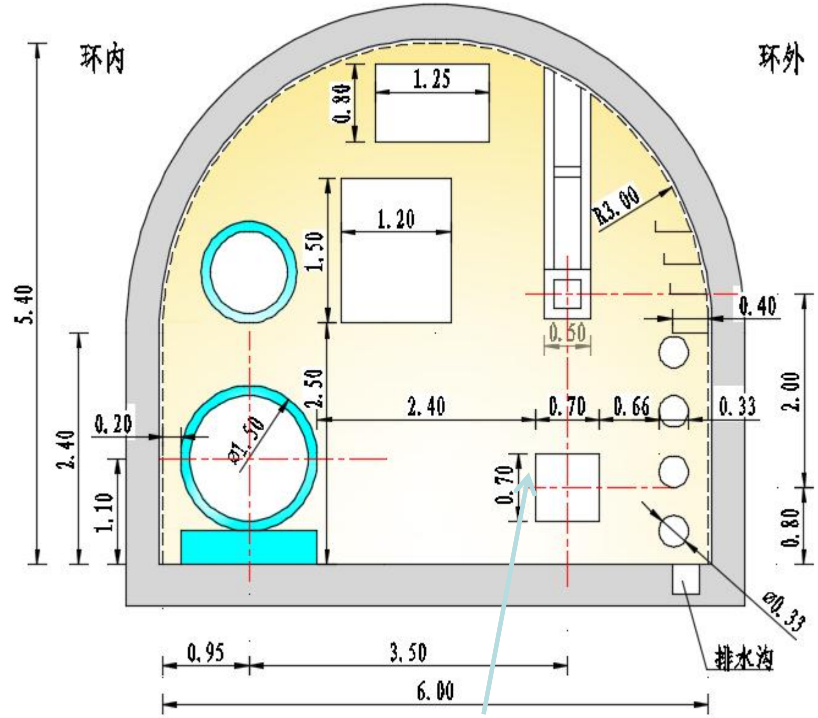
Parameter	Unit	Value		
		PreCDR	CDR	Ultimate
Circumference	km	54.4	100	100
C.M. energy	TeV	70.6	75	125-150
Dipole field	T	20	12	20-24
Injection energy	TeV	2.1	2.1	4.2
Number of IPs		2	2	2
Nominal luminosity per IP	$cm^{-2}s^{-1}$	$1.2x10^{35}$	$1.0x10^{35}$	-
Beta function at collision	m	0.75	0.75	-
Circulating beam current	A	1.0	0.7	-
Bunch separation	ns	25	25	-
Bunch population		$2.0x10^{11}$	$1.5x10^{11}$	-
SR power per beam	MW	2.1	1.1	-
SR heat load per aperture @arc	W/m	45	13	-

Layout and tunnel cross-section

SPPC Layout



Tunnel cross-section



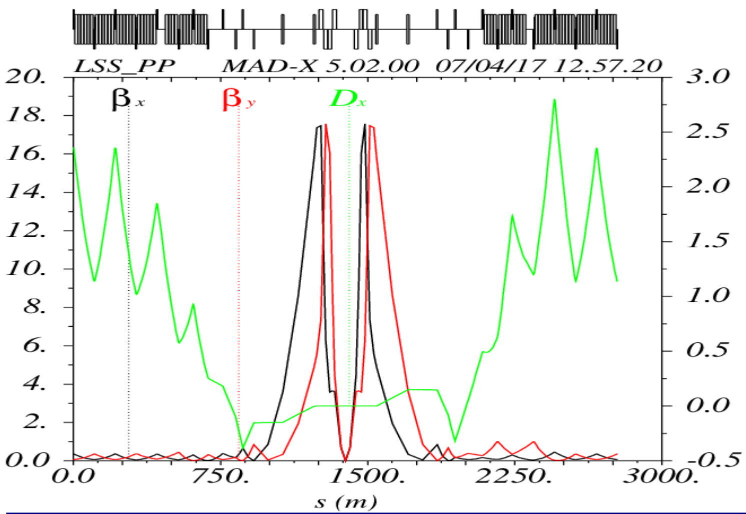
More space required for CEPC double-ring scheme

Collider Accelerator Physics
-Parameter list updating

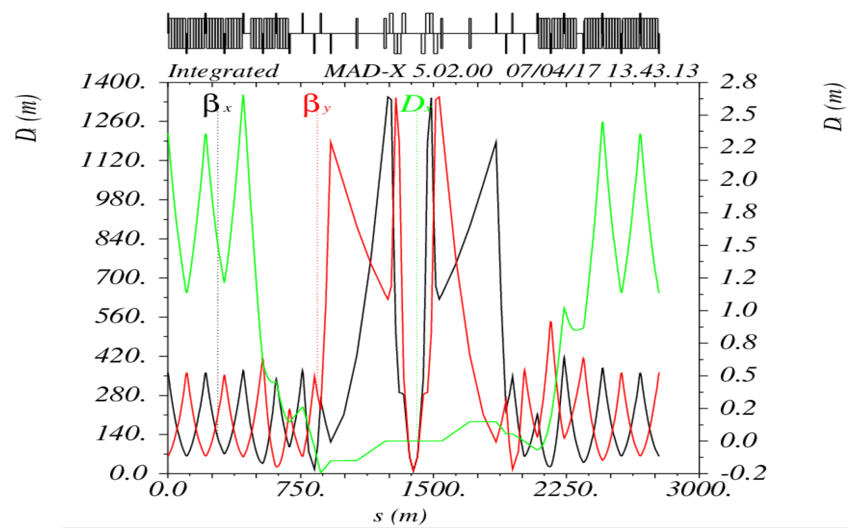
Parameter	Value	Unit
Main parameters		
Circumference	100	km
Beam energy	37.5	TeV
Lorentz gamma	39979	
Dipole field	12.00	T
Dipole curvature radius	10415.4	m
Arc filling factor	0.780	
Total dipole magnet length	65442.0	m
Arc length	83900	m
Total straight section length	16100	m
Energy gain factor in collider rings	17.86	
Injection energy	2.10	TeV
Number of IPs	2	
Revolution frequency	3.00	kHz
Revolution period	333.3	μs
Physics performance and beam parameters		
Nominal luminosity per IP	1.01E+35	$cm^{-2}s^{-1}$
Beta function at initial collision	0.75	m
Circulating beam current	0.73	A
Nominal beam-beam tune shift limit per	0.0075	
Bunch separation	25	ns
Bunch filling factor	0.756	
Number of bunches	10080	
Bunch population	1.5E+11	
Accumulated particles per beam	1.5E+15	
Normalized rms transverse emittance	2.4	μm
Beam life time due to burn-off	14.2	hour
Turnaround time	3.0	hour
Total cycle time	17.2	hour
Total / inelastic cross section	147	mbarn
Reduction factor in luminosity	0.85	
Full crossing angle	110	μrad
rms bunch length	75.5	mm
rms IP spot size	6.8	μm
Beta at the 1st parasitic encounter	19.5	m
rms spot size at the 1st parasitic encoun	34.5	μm
Stored energy per beam	9.1	GJ
SR power per ring	1.1	MW
SR heat load at arc per aperture	12.8	W/m
Critical photon energy	1.8	keV
Energy loss per turn	1.48	MeV
Damping partition number	1	
Damping partition number	1	
Damping partition number	2	
Transverse emittance damping time	2.35	hour
Longitudinal emittance damping time	1.17	hour

Lattice design

- **Different lattice designs**
  - Different schemes (100 TeV and 75 TeV @100 km)
  - Lattice at injection
  - Compatibility between CEPC and SPPC
  - Arc cells, Dispersion suppressors, insertions



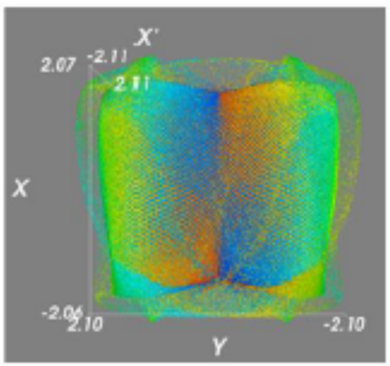
IP: at collision

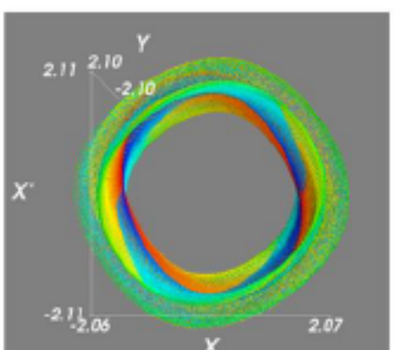


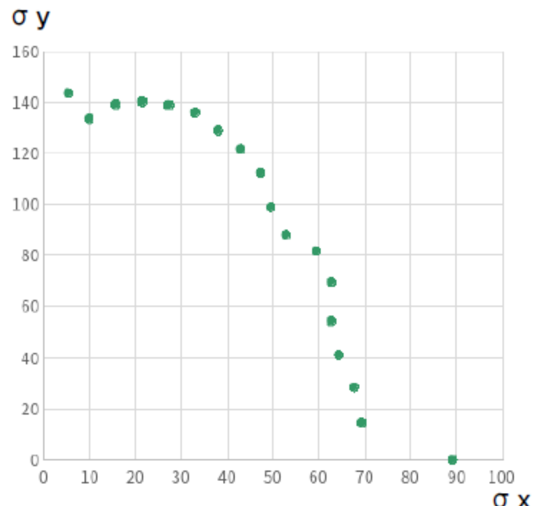
IP: at injection

Dynamic aperture study

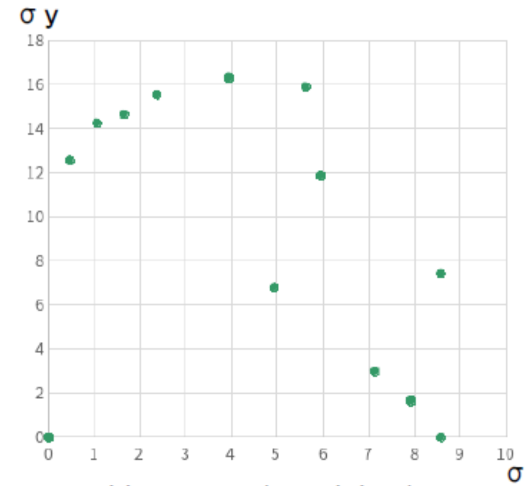
- **At collision energy**
- **At injection energy (Sixtrack code)**



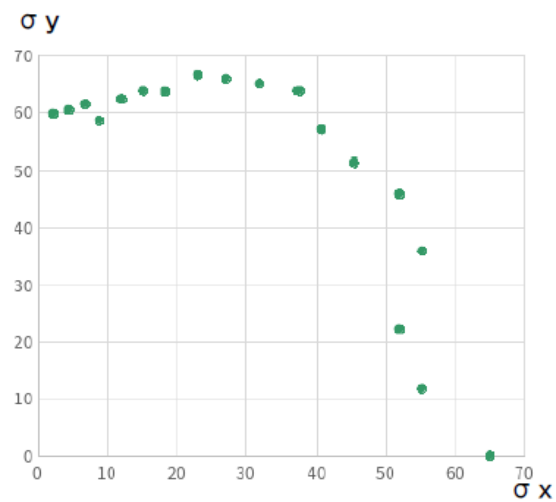




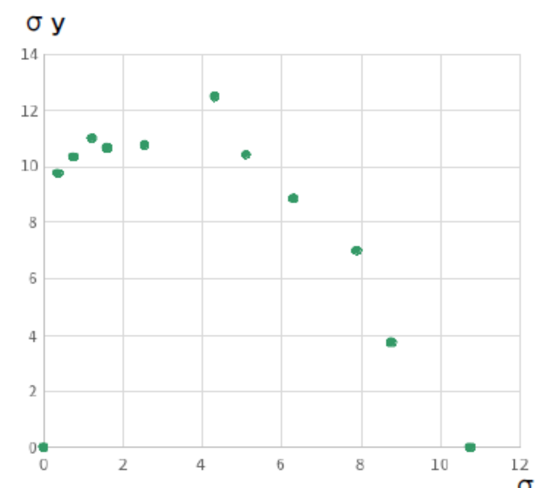
Adding sextuple without dipole error (chromaticity corrected)



Adding sextuple and dipole error (chromaticity corrected)



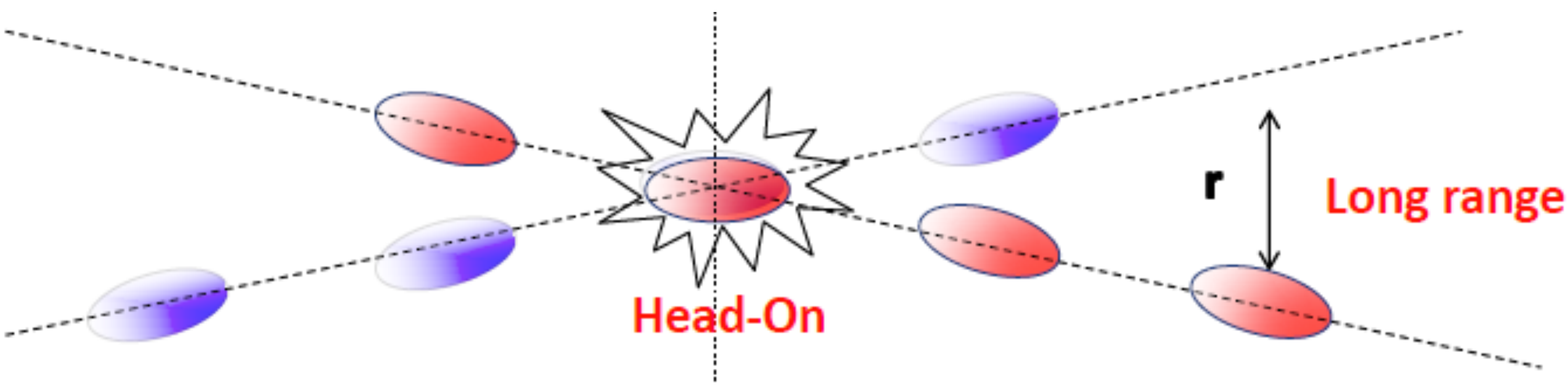
Adding sextuple without dipole error (chromaticity corrected)



Adding sextuple and dipole error (chromaticity corrected)

Beam-beam effects

- **Studying different effects (just started)**
  - Head-on interaction
  - Long-range interaction
  - Pacman effects
  - Orbit effects
  - Coherent beam effects
  - BB compensation methods (Electron lens, Compensation wires)

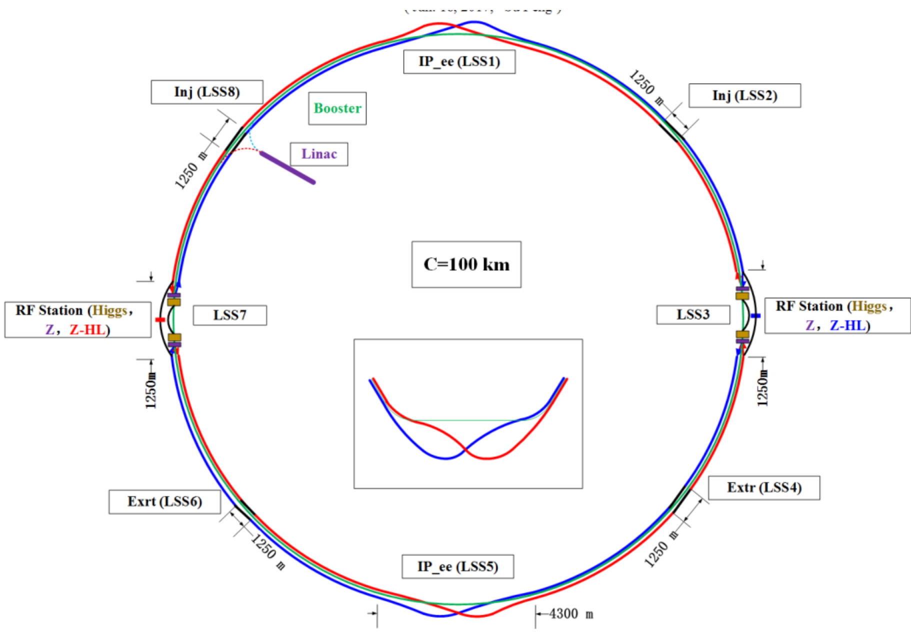


SPPC: normal bunch (164 LRBBI) Pacman bunch (82~164 LRBBI)

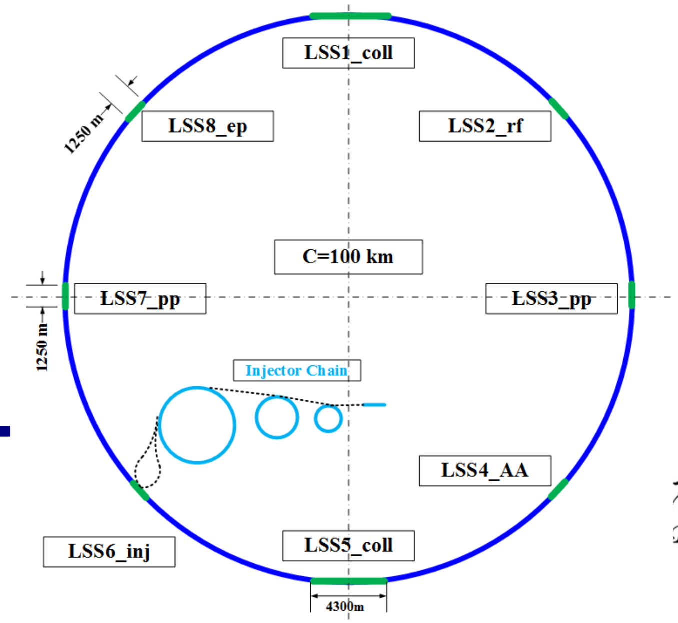
Compatibility between CEPC and SPPC

- CEPC first to be built, with potential to add SPPC later
- Allow ep collision in the future, three machines in one tunnel: e booster, ee double-ring collider, pp double-ring collider (keeping ee detectors together with SPPC in doubt)
- Several rounds of interactions between CEPC and SPPC design teams
- Layout: 8 long straights and arcs, LHC-like DS lattice, lengths for LSSs

CEPC double-ring layout- 100km



SPPC layout- 100km



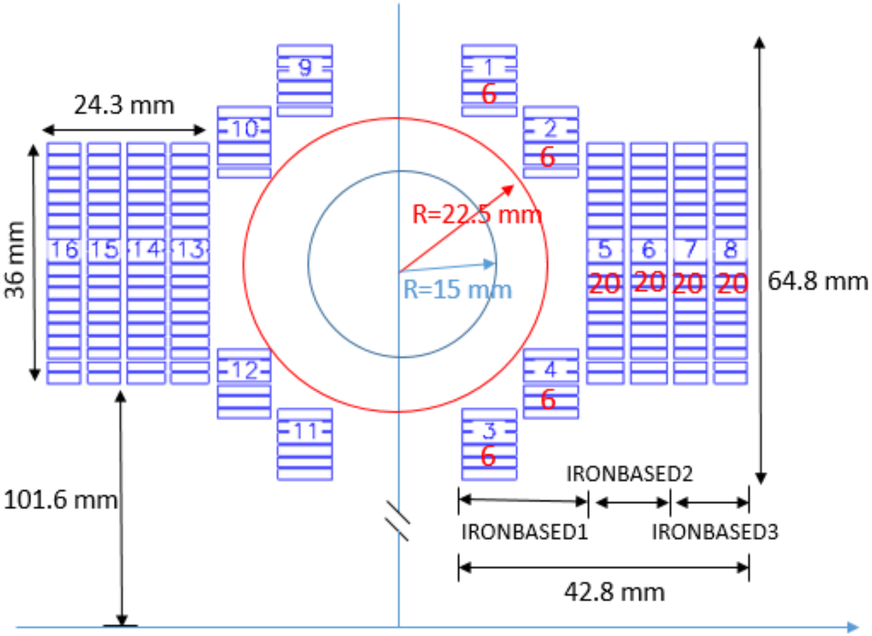
研究所 Physics

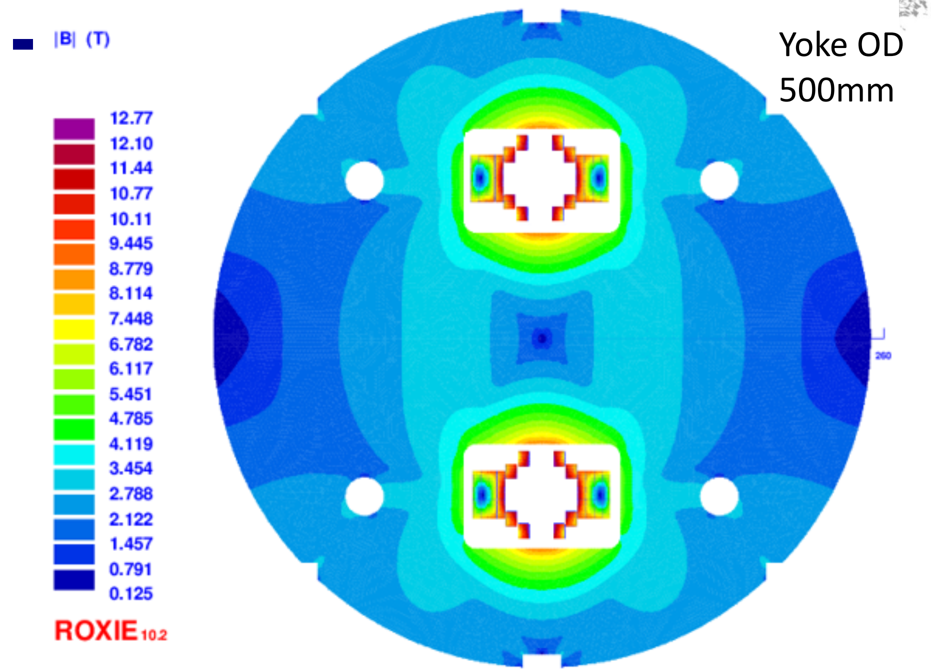
Technical challenges and R&D requirements
-High field SC magnets

- Following the new SPPC design scope
  - Phase I: 12 T, all-HTS (iron-based conductors)
  - Phase II: 20-24 T, all-HTS
- New magnet design for 12-T dipoles
- R&D effort in 2016-2018
  - Cables, infrastructure
  - Development of a 12-T Nb_3Sn-based twin-aperture magnets (alone, with NbTi, with HTS)
- Collaboration
  - Domestic collaboration frame on HTS superconductors (material, industrial and applications) formed in October 2016
  - CERN-IHEP collaboration on HiLumi LHC magnets

Design of 12-T Fe-based Dipole Magnet

C. Wang, E. Kong (USTC), Q. Xu et al.





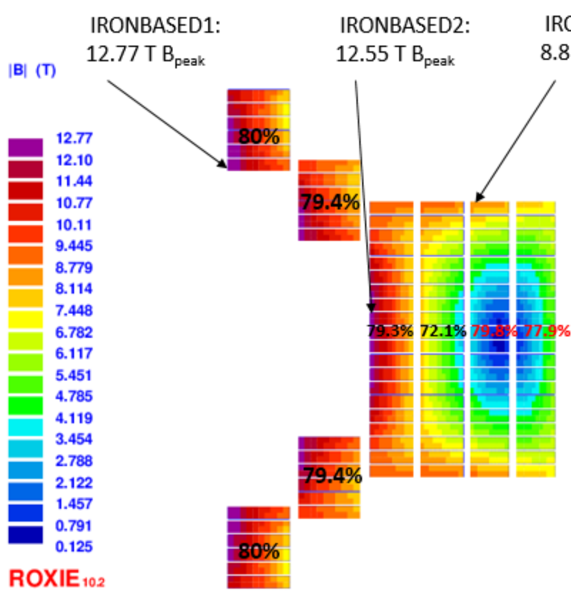


Table 1: Main parameters of the cables

Cable	Hight	Width-i	Width-o	Ns	Strand	Filament	Insulation
IRONBASED1	8	1.5	1.5	20	IRON-BASED	FE-BASED	0.15
IRONBASED2	5.6	1.5	1.5	14	IRON-BASED	FE-BASED	0.15
IRONBASED3	5	1.5	1.5	12	IRON-BASED	FE-BASED	0.15

Table 2: Main parameters of the strand

Strand	diam.	cu/sc	RRR	Tref	Bref	Jc@ BrTr	dJc/dB
IRON-BASED	0. 802	1	200	4. 2	10	4000	111

For per meter of such magnet, the required length of the iron-based strand: 6.08 Km

Domestic Collaboration on HTS

In October 2016, A consortium for high-temperature superconducting materials, industrialization and applications was formed in China, with participation of major research and production institutions on HTS.

China is actually leading the development of Fe-HTS technology in the world; world-first 100-m Fe-HTS wire was made by CAS-Institute of Electrical Engineering in the last year .

研究所 Physics

Other important technical challenges

- Collimation system: new materials to reduce impedance and tolerate more heat deposit
- Very large scale cryogenics system: SC magnets, SRF, beam screens
- Sophisticated beam feedback system: to control the emittance heat-up and suppress beam instabilities
- Machine protection system: fast detection of abnormal function, reliable beam abort (kickers and septa)
- There are also many technical challenges in building high-power injector chain: e.g. RF systems for p-RCS and MSS, fast ramping for SS

CEPC funding

HEP seed money

11 M RMB/3 years (2015-2017)

国家重点研发计划
项目预申报书

FY 2016

Ministry of Science and Technology
Requested 45M RMB; **36M RMB approved**

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预研究
所属专项：	大科学装置前沿研究
指南方向：	新一代粒子加速器和探测器关键技术和方法的预先研究
推荐单位：	教育部
申报单位：（公章）	清华大学
项目负责人：	高原宁

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

IHE

~60M RMB CAS-Beijing fund, talent program

~500M RMB Beijing fund (light source)

year 2017 funding request (45M) to MOST and other agencies under preparation

funding needs for carrying out CEPC design and R&D should be fully met by end of 2018

Collaboration and workshops

- a major workshop on CEPC
- global collaboration
- examines R&D status
- CDR – draft chapters
  - a major push
- CEPC organization update

China enterprise consortium promoting CEPC

Enterprise Consortium

- helps & guides industry；
- win their support for CEPC；
- enhance CEPC quality, reduce cost；
- ……

系统	负责人	序号	公司名称	所在地	企业类型
功率源	周祖圣	1	昆山国力电子科技股份有限公司		
		2	合肥雷科电子科技有限公司		
		3	成都凯腾四方数字广播电视		
		4	湖北汉光科技股份有限公司		
		5	北京北广科技股份有限公司		
超导磁铁	徐庆金	6	上海上创超导科技有限公司		
		7	上海超导科技股份有限公司		
		8	无锡统力电工股份有限公司		
		9	西部超导材料科技股份有限公司		
		10	无锡友方电工股份有限公司		
低温系统	李少鹏	11	合肥聚能电物理高技术开发有限公司		
		12	安徽万瑞冷电科技有限公司		
		13	无锡市创新低温环模设备科技有限公司		
		14	中船重工鹏力（南京）超低温技术有限公司		
		15	北京中科富海低温科技有限公司		
真空系统	董海义	16	上海三井真空设备有限公司		
		重复	合肥聚能电物理高技术开发有限公司		
		17	合肥科烨电物理设备制造有限公司		
		18	沈阳慧宇真空技术有限公司		
		19	希泰焊接波纹管（辽宁）有限公司		
微波系统	张敬如	20	湖北汉光设备股份有限公司		
		21	北京高能锐新科技有限责任公司		
		重复	上海三井真空设备有限公司		
		22	北京鼎荣达科技有限公司		
		23	上海西曼工程技术服务公司		
		24	惠州市华仑机电有限公司		
磁铁系统	康文	25	上海克林技术开发有限公司		
		26	上海原子核研究所实验工厂		
		27	上海缘磁机电科技有限公司		
		重复	合肥聚能电物理高技术开发有限公司		
		重复	北京高能锐新科技有限责任公司		
电源系统	陈斌	28	艾德克斯电子（南京）有限公司		
		29	北京博兴科源电子技术有限公司		
		30	天水电气传动研究所有限责任公司		
		31	西安爱科赛博电气股份有限公司		
		32	西安宏宇电气有限公司		
机械系统	屈化民 王海静	重复	北京高能锐新科技有限责任公司		
		重复	合肥聚能电物理高技术开发有限公司		
		重复	合肥科烨电物理设备制造有限公司		
		33	北京北方车辆集团有限公司		
		重复	惠州市华仑机电有限公司		
		34	上海宝冶工程技术有限公司		
		35	南京晨光集团有限责任公司		
		36	北京工研精机股份有限公司		
辐射防护	马忠剑	37	北京艾克塞斯科技发展有限责任公司		
		38	天津瑞隆辐射防护工程有限公司		
		39	北京市射线应用研究中心		
		40	科雁方舟智能控制技术（北京）有限公司		
		41	天津市万木辐射防护工程有限公司		
		42	北京华威博实科技有限公司		
束测	随艳峰	重复	上海三井真空设备有限公司		
		43	浩德科仪（北京）科技有限公司		
控制	李刚	44	长飞光纤光缆股份有限公司		
基建		重复	北京高能锐新科技有限责任公司		
超导高频	翟纪元、 沙鹏	重复	北京高能锐新科技有限责任公司		
		45	宁夏东方超导科技有限公司		
		46	中国航发北京航空材料研究院		
		47	北京晶纳科技有限公司		
		48	安徽华东光电技术研究所		
		49	北京富斌盛世真空设备有限公司		
		重复	沈阳慧宇真空技术有限公司		
磁体	朱应顺	重复	无锡统力电工股份有限公司		
		重复	西部超导材料科技股份有限公司		
准直	董岚	50	广州南方测绘科技股份有限公司		
		51	苏州一光仪器有限公司		
		52	中国科学院西安光学精密机械研究所		
		53	汉中远航精密机械制造有限公司		
		54	北京普达迪泰科技有限公司		
		55	贵阳三荣精密工具有限公司		
		56	中国航空工业集团公司北京长城计量测试技术研究所		
		57	中国科学院光电研究院		
		重复	惠州市华仑机电有限公司		
		58	易思维（天津）科技有限公司		
探测器1	欧阳群	59	成都飞机工业（集团）有限责任公司		
		60	河北航凌电路板有限公司		
		重复	沈阳慧宇真空技术有限公司		
探测器2	胡涛	61	深圳市金百泽电子科技股份有限公司		
		62	北京天合精机科技有限公司		
		63	天津市森特尔新技术有限公司		
		64	森特尔院士专家工作站核电子学与核探测技术产业创新战略联盟		

Summary

1. The CEPC CDR is now in progress at IHEP, China, with the new design of double-ring;
2. R&D for CEPC/SppC needs the support of funding and human resources;
3. Technological systems, both of CEPC and mainly HTS magnet of SppC, are gradually developed, with the support from industry in China;
4. From CEPC to SppC, a lot of work ahead, and more budget and collaborations on R&D are expected.

Thank you for your attentions !