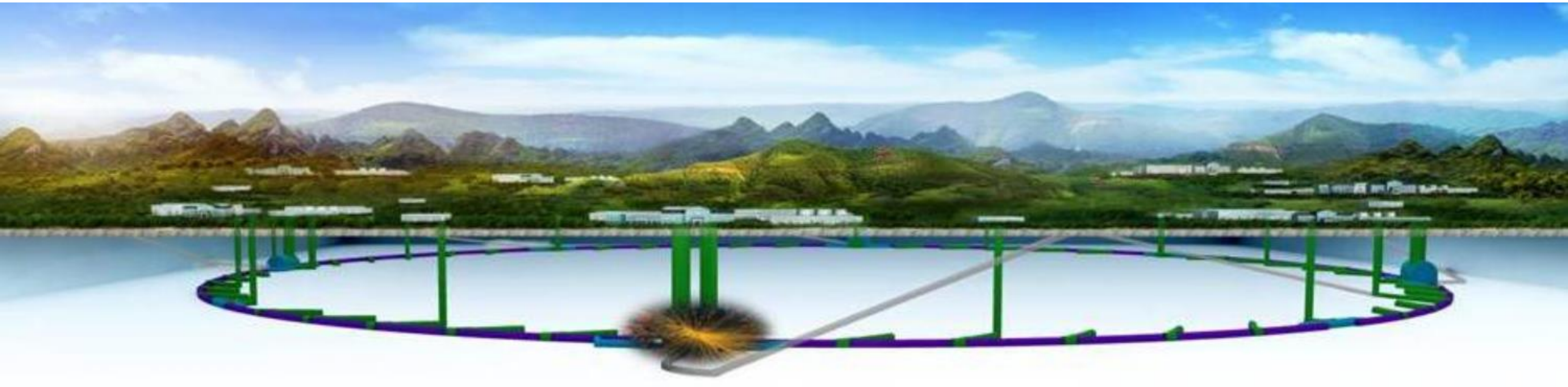
CEPC Project Overview
&
Implementation of IAC Recommendations

XinChou Lou
Institute of High Energy Physics (Beijing)

The 6th CEPC IAC Meeting



Outline

Introduction

- Goals and plan
- Roadmap and schedule

CEPC project development

- CEPC management update
- Design-phys. enhancement, R&D, infrastructure
- International collaboration
- Site investigation & domestic relations

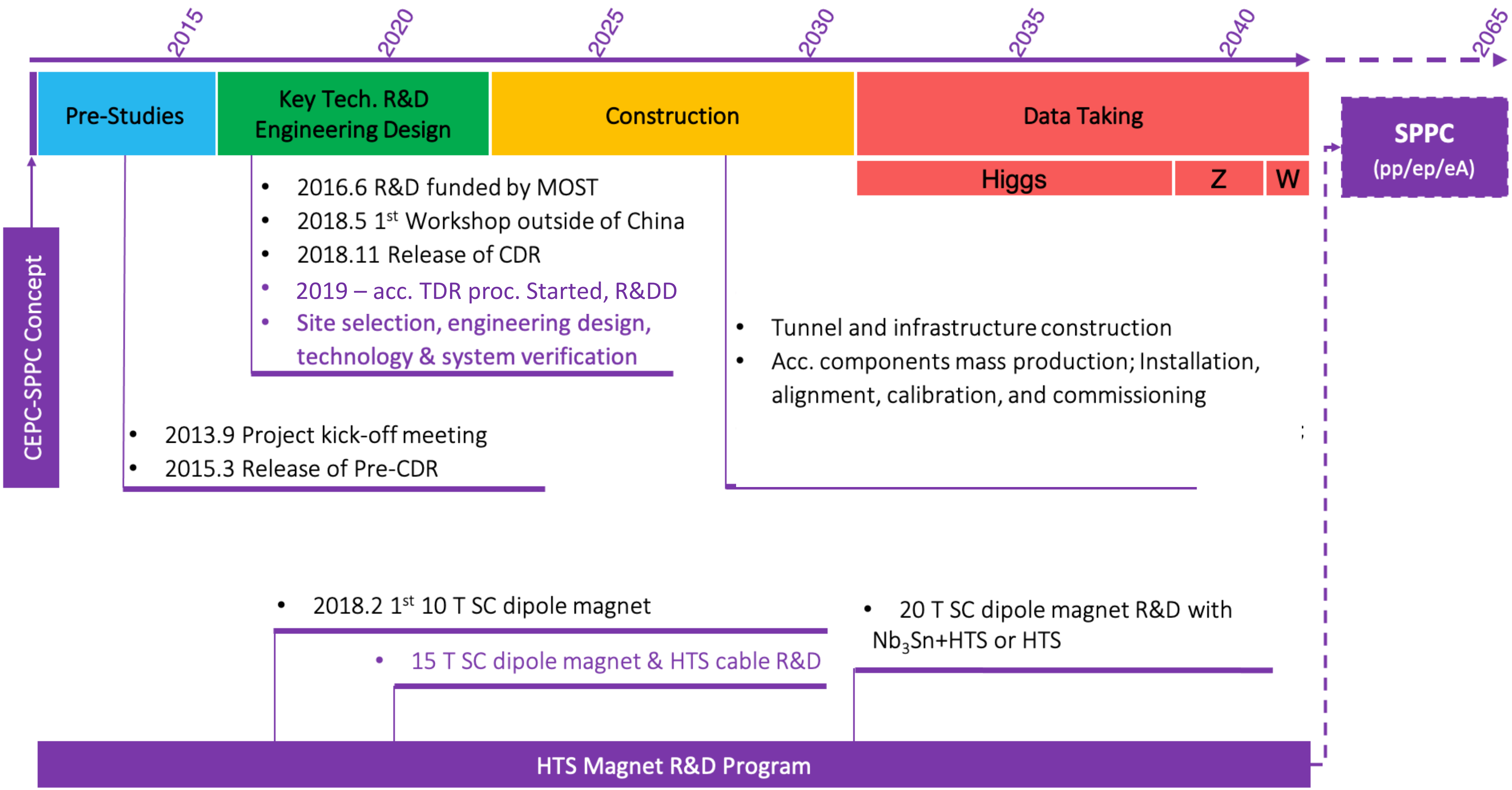
Summary

Goals and Plan

- Design enhancement + R&D
- Validation, & industrial preparation
- Best prepare CEPC for national government's approval
- Realization of the CEPC project, the experimental program and pursue the science
- International collaboration and coordination

CEPC Roadmap and Schedule (ideal)

CEPC Project Timeline



Current (temporary) CEPC Organization

Only for Chinese

October 2020

Institutional Board
Y.N. GAO
J. GAO

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

IAC
Young-Kee Kim, ….

Thank you to those who have served

Welcome Haijun, Jianbei, Chenghui, and YuHui

Project Director
XC LOU
HJ Yang (deputy, SJTU)

tasks:
Intl Relation– J GAO
PR – YN GAO
Conf. – J.Shan
TDR – XC Lou et al.
……

Accelerator
J. GAO(IHEP)
JY Tang(SPPC,IHEP)
CX YU （IHEP）
YH Li (IHEP)

Detector
JoaoCosta(IH
JB Liu (USTC)
JC Wang(IHE

Beyond CDR

Design & detector-simulation enhancement, R&D, and infrastructure

Development – expert committees

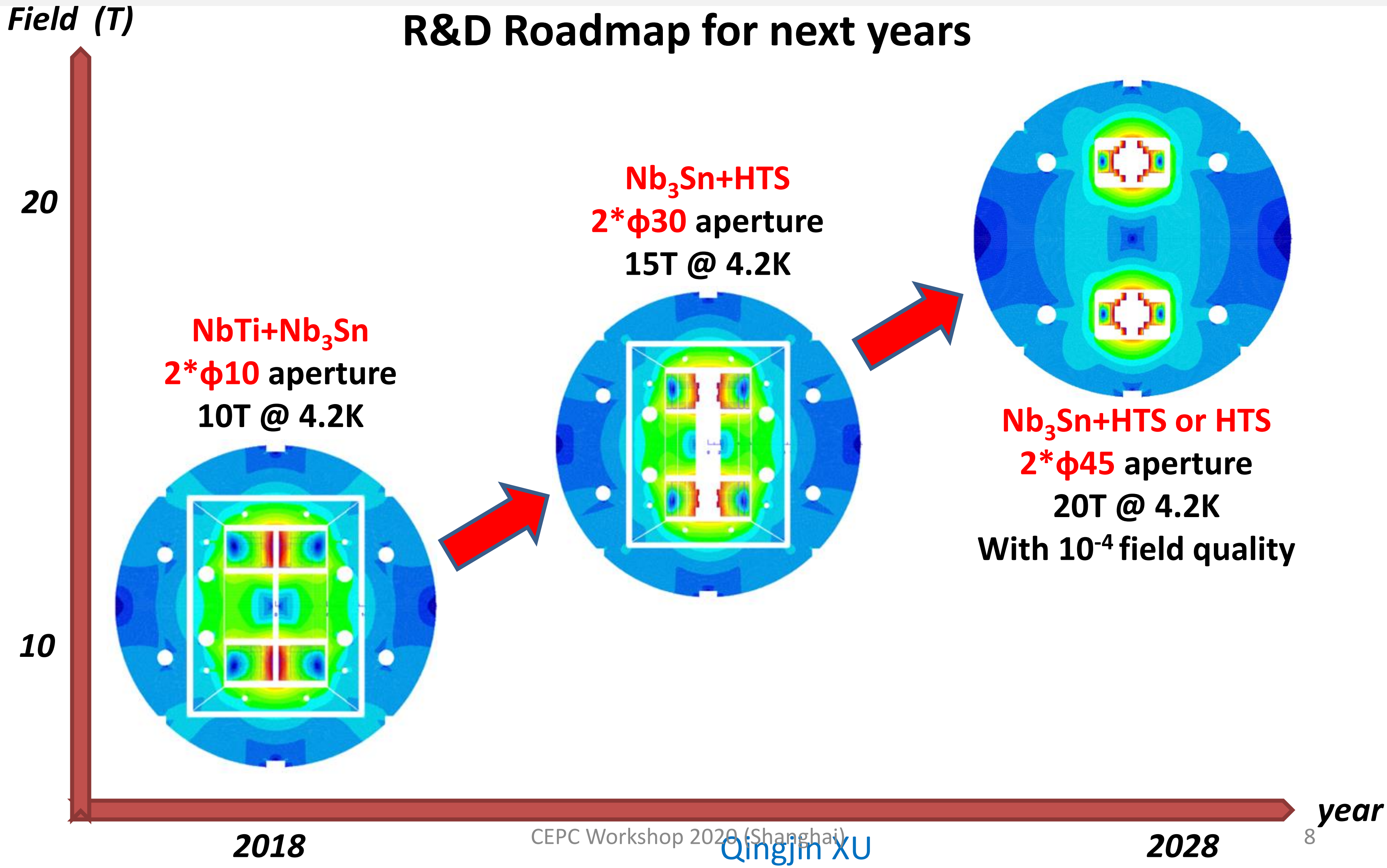
- **Accelerator Review Committee** – recommended by the IAC, established and met in November, 2019
- **Detector R&D Review Committee** – recommended by the IAC, a large committee (~16 members) has been established; first meeting in November 2019

We are benefiting greatly from these committees

CEPC DRD – aiming at organic growth and creativities

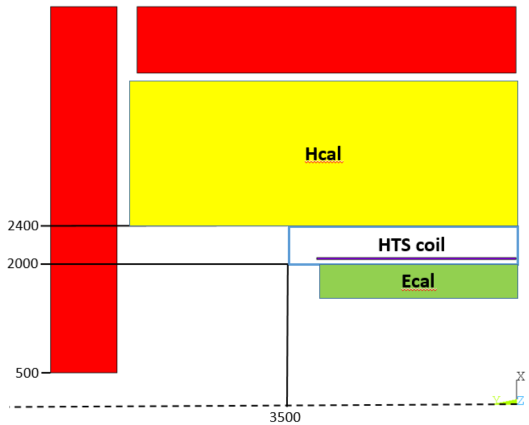
Status and Plan of the High Field Magnet R&D for Future Accelerators

R&D Roadmap for next years

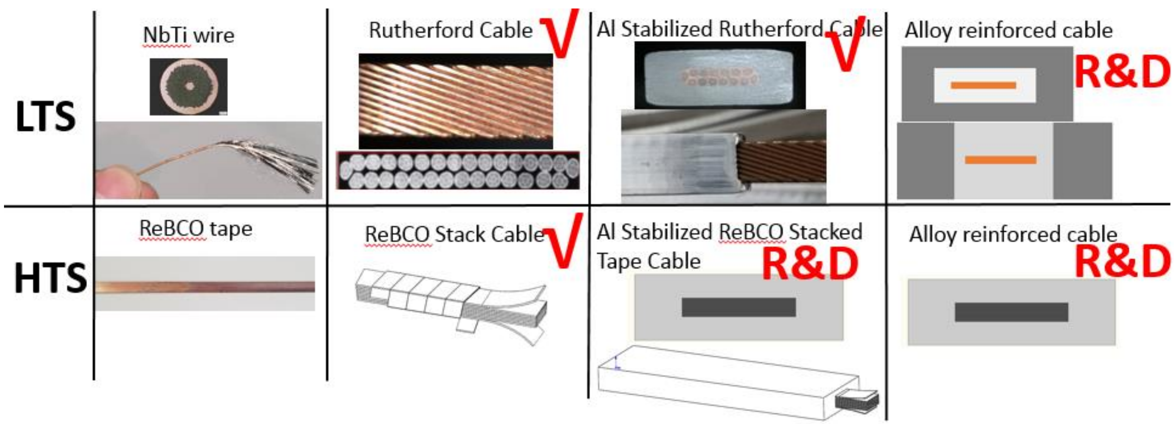


Detector magnet R&D

Magnet locates between Ecal and Hcal



Requirements: Low mass & Small radial space
R&D: high strength superconducting cable



Magnet Parameters	Value
Inner radius	**2 m**
Outer radius	**2.4 m**
Length	**7 m**
Central magnetic field	**3 T**

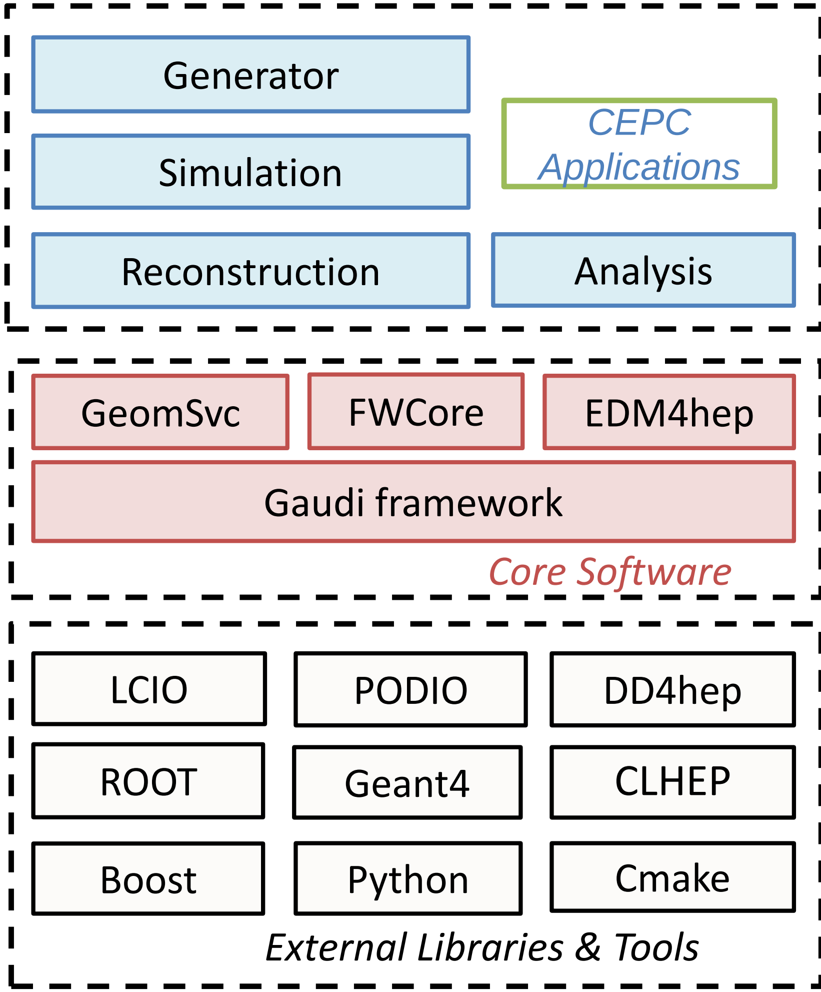
Highlights:
1, Domestic LTS and HTS cable;
2, New HTS cable and large HTS magnet in the world.

Challenge:
1, ultra-thin solenoid magnet;
2, low mass.

Other R&D work:
- Large coil winding process R&D;
- Cryogenic system R&D: thermal siphon principle experiment platform was built based on liquid helium or forced flow cooling;
- Large HTS coil R&D;
- Low mass vacuum vessel structure R&D

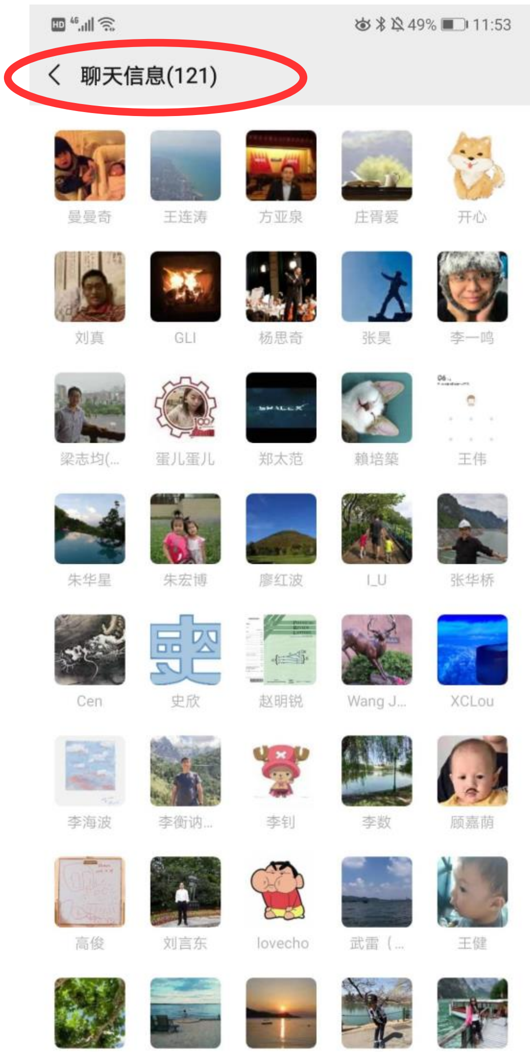
CEPC Software

- The CEPC software (CEPCSW)
  - encompasses core software and CEPC applications for simulation, reconstruction and analysis which were built on the top of external libraries
  - is fully integrated with the Key4hep, a turnkey software stack developed for the future experiments i.e. CEPC, FCC, CIIC and ILC etc.
- Core software
  - Gaudi was employed as the underlying framework which defines interfaces to all software components and controls their execution.
  - FWCore was used to manage event data objects defined by EDM4hep. Both FWCore and EDM4hep are Key4hep packages.
  - DD4hep-based geometry service was implemented to provide a unified way to access detector geometry data.



International collaboration

CEPC Snowmass LoIs

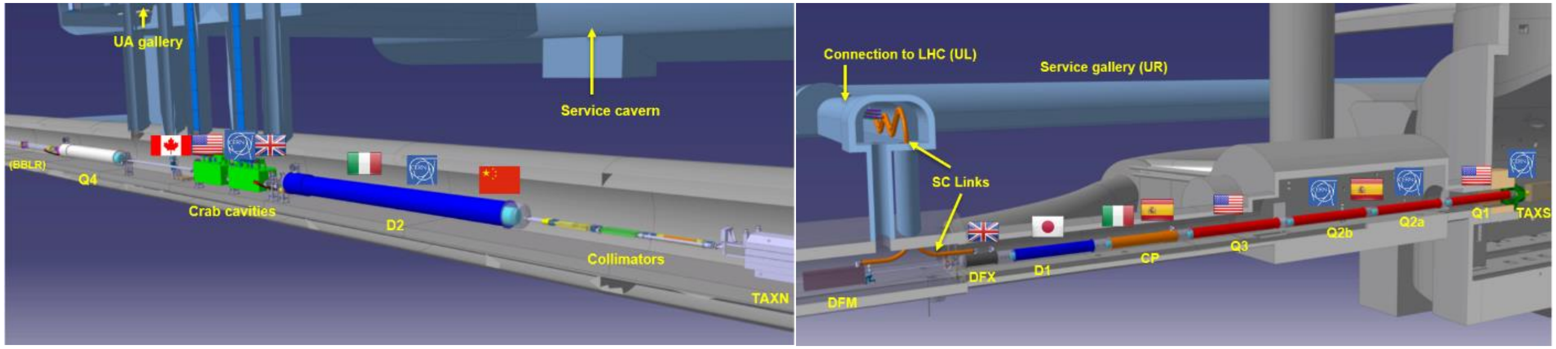


title	ID	author	link
Study of electroweak phase transition in exotic Higgs decays with CEPC Detector simulation	229-v1	Michael Ramsey-Musolf	URL
Exclusive Z decays	226-v1	Qin Qin	URL
Measurement of the leptonic effective weak mixing angle at CEPC	233-v1	Siqi Yang	URL
Heavy Neutrino search in Lepton-Rich Higgs Boson Rare Decays	244-v1	Yu Gao	URL
Higgs boson CP properties at CEPC	227-v1	Xin Shi	URL
Measurement of branching fractions of Higgs hadronic decays	228-v1	Yanping Huang	URL
Feasibility study of CP-violating Phase phi_s measurement via Bs->J/PsiPhi channel at CEPC	230-v1	Mingrui Zhao	URL
Probing top quark FCNC couplings tqr, tqZ at future e+e- collider	231-v1	Peiwen Wu	URL
Searching for $B_s \to \phi \nu \nu$ and other b->dvv processes at CEPC	232-v1	Yanyun Duan	URL
Probing new physics with the measurements of e+e- -> W+W- at CEPC with optimal observables	234-v1	Jiayin Gu	URL
NNLO electroweak correction to Higgs and Z associated production at future Higgs factory	235-v1	Zhao Li	URL
SUSY global fits with future colliders using GAMBIT	237-v1	Peter Athron	URL
Probing Supersymmetry and Dark Matter at the CEPC, FCCee, and ILC	238-v1	Waqas Ahmed	URL
Search for t + j + MET signals from dark matter models at future e+e- collider	239-v1	Peiwen Wu	URL
Search for Asymmetric Dark Matter model at CEPC by displaced lepton jets	240-v1	Mengchao Zhang	URL
Dark Matter via Higgs portal at CEPC	241-v1	Tianjun Li	URL
Lepton portal dark matter, gravitational waves and collider phenomenology	242-v1	Jia Liu	URL
CEPC Detectors Letter of Intent	245-v1	Jianchun Wang	URL

Submitted 35 LOIs

(4 CEPC/SppC, 13 detector, 1 Software Key4Hep， 17 physics)

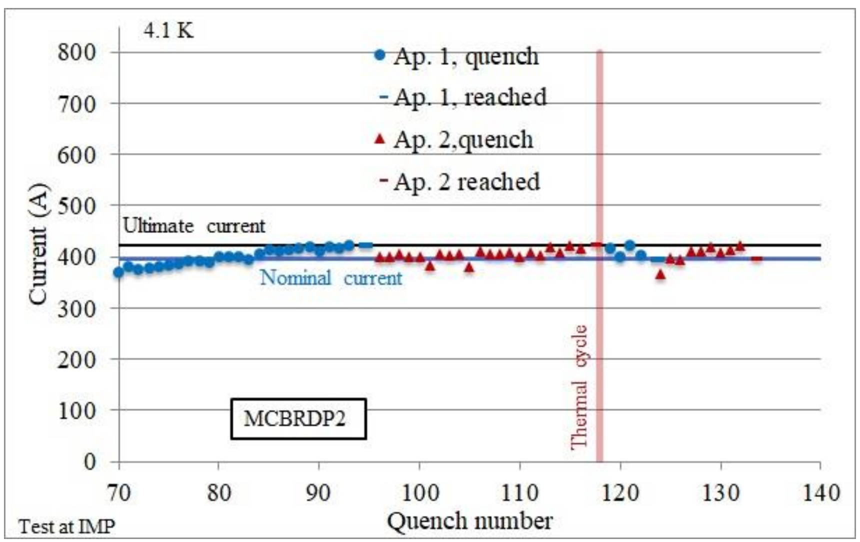
Status of the China-CERN HL-LHC CCT Project

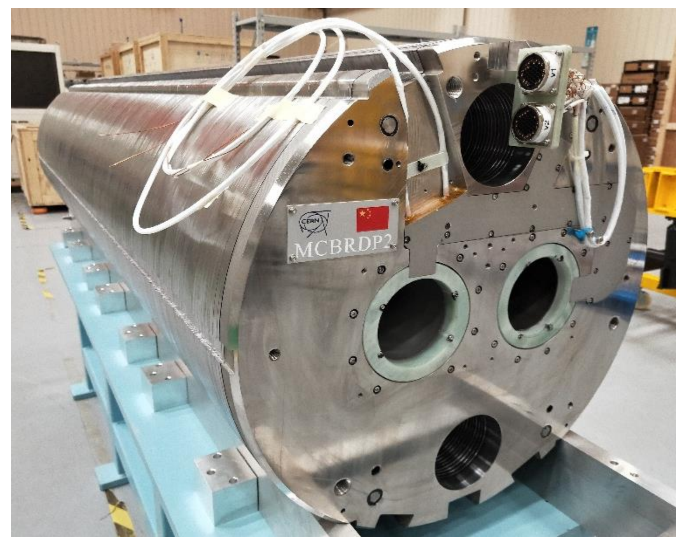


Layout of the HL-LHC Magnets and Contributors

China will provide 12+1 units CCT superconducting magnets for the HL-LHC project

After more than 1 month test and training at 4.2K, both apertures reached the design current and ultimate current, and the field quality is within the limit.





Qingjin XU, also merged slide from Jie.

<u>The 1st prototype CCT magnethas been sent to CERN. A good start for the 12 units series production.</u>

Progress and updates – Intl Collaboration

- **Strengthen cooperation with CERN** （**paying close attention to EPPSU)**
- **Active in CALICE collab., ILD TPC collab., RD collab.**

- First international workshop on CEPC in Europe – Rome May, 2018
- Second CEPC workshop (EU) in Oxford, UK, April 15-17, 2019
- **Third planned for Marseille, France, May 4-6, 2020**
  postponed to 2021 due to the COVID-19 pandemic
- **First US workshop at UChicago, September 16-18, 2019**
- **Second US workshop April, 2020 (online)**
  Catholic University in Washington DC, USA
- **HongKong IAS HEP Program, 2019, 2020, …**
- **2019 CEPC International workshop at IHEP (~360)**
- **2020 CEPC International workshop in Shanghai (~400)**
- **Fifth CEPC IAC meeting (Nov. 21-22, 2019), 6th Oct. 29-30,2020**

2020 CEPC International workshop in Shanghai

October 25-28, 2020 in Downtown Shanghai

- ~400 Participants (170 in person, 130 on ZOOM)
- 187 talks (91 domestic speakers, 97 international speakers)
- Program ran from 8:30 to 23:30
- Plenary in the evenings (Shanghai time) to maximum participation
- Many real progress in design, R&D, …
- Presentations on other projects and development

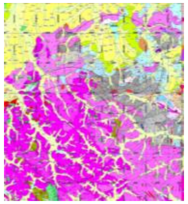
A few observations and consideration:

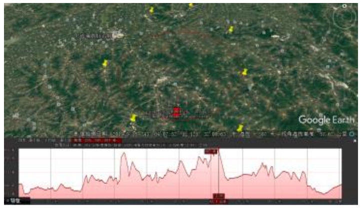
- minor network issues & mostly smooth progression
- three day program filled with talks but few real discussion
- long day (night) very exhausting to many participants
- make future annual intl. workshop CEPC "**CEPC Week**"?
- or conference (two days) + workshop (3 days)

……

Site investigation & domestic relations

CEPC Site Selection Status

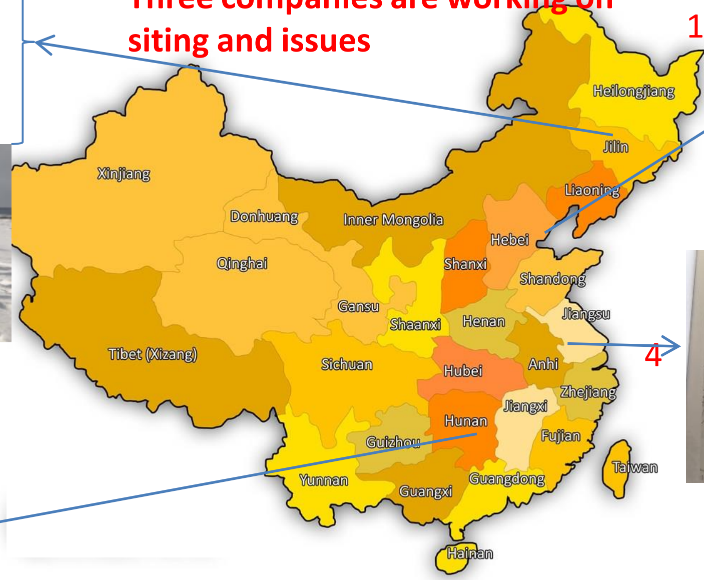




5

Three companies are working on siting and issues

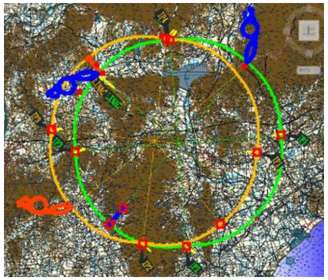
2019.12月8-11 and 2020.1.8-10
Chuangchun sitings update



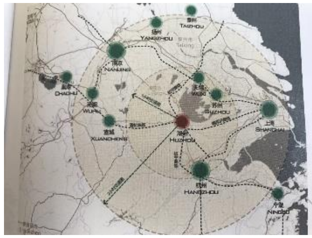
1

4

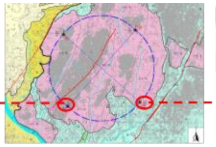
6

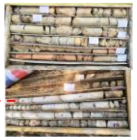


2020.9.14-18 Qinhuangdao updated



2019.12.16-17 Huzhou siting update





2019.08.19-20 Changsha siting update

1) Qinhuangdao, Hebei Province（Completed in 2014）
2) Huangling, Shanxi Province（Completed in 2017)
3) Shenshan, Guangdong Province(Completed in 2016)
4) Huzhou, Zhejiang Province (Started in March 2018)
5) Chuangchun, Jilin Province (Started in May 2018)
6) Changsha, Hunan Province (Started in Dec. 2018)

Strong support from local governments

Implementation of IAC Recommendations

Response to IAC recommendation

Is the accelerator TDR on track? What should be improved and how to achieve the improvement?

The IAC was pleased to see the advancements on the work performed up to now toward the TDR. The quality of the work performed, how most important issues were addressed, even if not already solved, and the design work on-going to increase the luminosity performances at Higgs and Z were highly appreciated. Several improvements on the design parameters over the CDR have been presented including:

- higher luminosity at H (5.2×10^{34} vs 2.9×10^{34})
- "High-Lumi" for Z (102×10^{34} vs 32×10^{34})
- assuring compatibility for top-pair production at the appropriate energy (~365 GeV)
- higher energy injection into the booster with a longer linac
- capability to handle 50 MW SR power
- compatibility with SppC collider layout

All of them expand the capability of the project with a **moderate increase of the cost**.

Response:

TDR design of CEPC SRF system is aiming to fulfill requirements of all the above improvements over CDR.

SRF layout, configuration, parameters, specifications and cost will be upgraded accordingly (try to converge in the end of 2020. re-baseline time? approval procedure?).

Jiyuan Zhai

IAC Recommendation 8 and IARC 11-2

IAC Recommendation 8: Define the new parameters as a "new baseline", to make all systems consistent with them. A proper documentation database and an approval procedure for new baselines must be established, to achieve coherence through the entire project. All related parameters including RF and the injector should match the new baseline. … TDR … "goal" and time frame must be clearly stated consistently.

IARC answers to the charges: Separate types of RF cavities should be optimized for each energy using bypass lines.

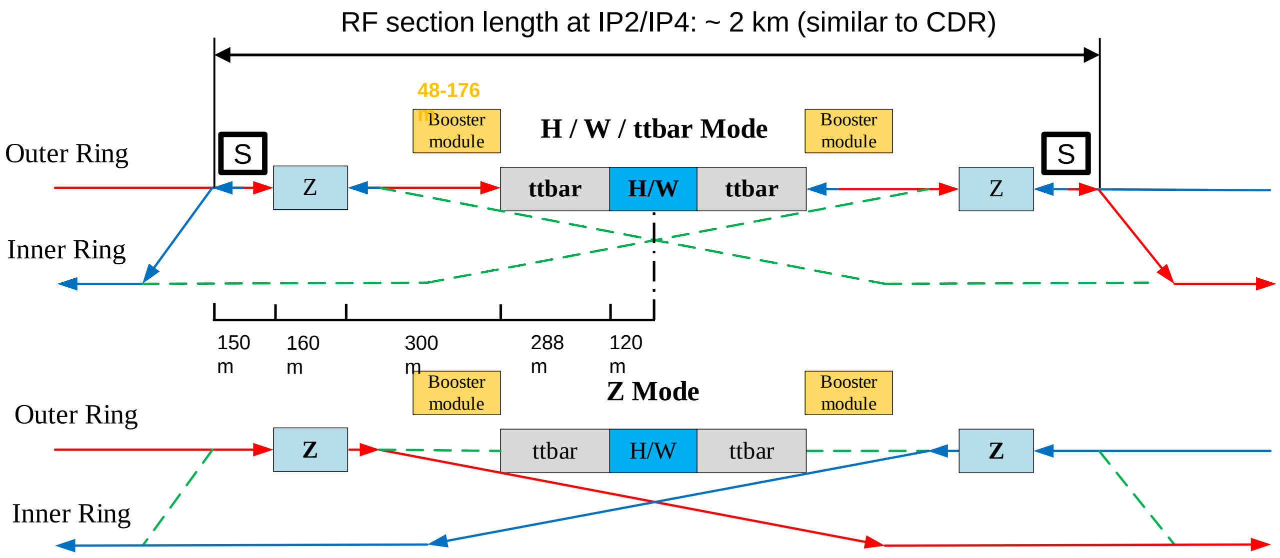
IARC Recommendations 11-2: Optimization to produce the required performance for the higher luminosity Z running is essential. Using single-cell cavities in the collider ring also for the Higgs running gives cavity performance requirements not yet regularly achieved anywhere in the world. A scheme with bypasses is more realistic.

Response:

- Collider ring cavity by-pass scheme and counter-phase scheme recently proposed to solve the outstanding problems (HOM and beam loading) of SRF system operation in high luminosity Z mode (30 MW) and the 50 MW power upgrade.
- Booster ring cavity HOM issues stand out for high luminosity Z, but will be within control.
- New RF layout and parameters optimization at each energy with the new schemes is ongoing and were presented in CEPC2020 workshop. Booster SRF issues and other issues will also be addressed.

Jiyuan Zhai

New RF Section Layout for CEPC



Could have 80 more separate 1-cells (thus 40 less 2-cells) for W and further Z optimization while keep the total cell number for a reasonable H cavity gradient.
If consider ttbar switch to other modes, more bypass is needed. Booster bypass?

- H/W/tt use common cavities (2-cell for H/W, 5-cell for tt) for two beams. (Less than) Half filled to avoid collision in RF section. If fully filled, bunch spacing should be more than 4 km (< 25 bunches per beam).
- Z uses separate high current 1-cell cavities for two beams and **by-pass** H/W/tt cavities.
- Allow **seamless mode switching** with **unrestricted performance** of each mode until the power limit (**baseline and upgrade**). Low risk.
- A few percent more cost to **unleash CEPC potential** and **more flexible operation**.

See Jie Gao's talk

IAC Recommendation 9 and IARC 11-1

IAC Recommendation 9: Clarify the **timetable with appropriate milestones**, **including prototyping**. Not every technical detail and drawing will be necessary at the completion of the TDR.
IAR Recommendations 11-1: It is important to make a clear distinction between long-term R&D, such as high-Tc coating of cavities, peripheral development, such as Centrifugal Barrel Polishing, and high-priority items to produce **industrial-scale production** required for CEPC construction. Given limited resources, particularly of staff, **priority must be given to the latter**.

Response: CEPC SRF system TDR R&D and Industrialization Plan

2019-2020:

- SRF system TDR design and optimization
- High Q, high gradient cavity, high power components and other key technology R&D
- 650 MHz high Q short cryomodule prototyping
- PAPS SRF facility construction

2021-2022:

- SRF system TDR design re-baseline, engineering design
- 650 MHz high Q short cryomodule operation and improvement
- 1.3 GHz high Q full cryomodule prototyping
- 650 MHz high current cryomodule design (and prototyping?)
- PAPS SRF facility commissioning, operation and upgrade
- Industrialization in synergy with other SRF projects in China

Jiyuan Zhai

IAC Recommendation 10

In order to build up **international involvement** in the project, draw up a **list of components likely to require a second source**, and identify **potential international suppliers**.

Response:

In-kind contribution: high-lumi and high power Z cavity cryomodules, ttbar cavity cryomodules (RF source, cryogenics …)

Import components:

- Feedthroughs, HOM antennas and pickup antennas, KYOCERA, Japan
- All metal gate valves (RF-shielded, class-10 clean, 2 K), VAT, Switzerland
- All metal angle valves (class-10 clean, 2 K), ULVAC, Japan
- Vacuum gauges, RGA, leak detector, PFEIFFER, INFICON, Germany
- Vacuum pumps, LEYBONBL, Germany
- Ceramics for input coupler windows, MOGAN, Germany
- OFHC copper material for input coupler windows, LUVATA, Finland
- Cryogenic step motors, PHYTRON, Germany
- Piezo actuators, PI, Germany
- Flux gates, BARTINGTON, UK

Jiyuan Zhai

IAC Recommendation 11

Build **international and domestic collaborations** in several critical areas, e.g., MDI, **SC-RF**, polarization, beam dynamics (beam-beam, dynamic aperture, etc.), C-band linac, and RF sources.

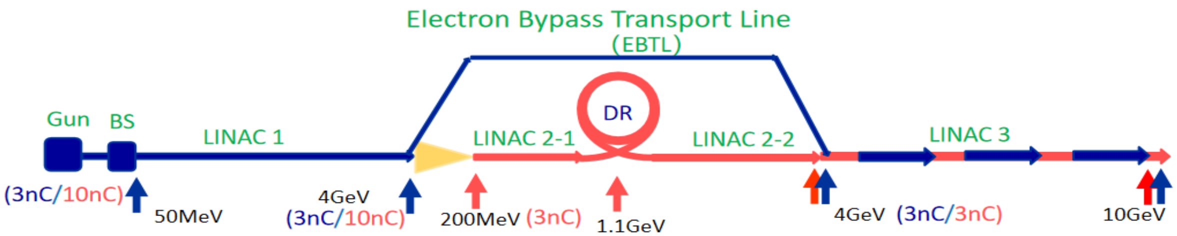
Response:

- **CEPC SRF domestic collaboration**
  - Organization: CEPC SRF Collaboration kick-off soon. Members: IHEP, PKU and 5 companies.
  - Activities: Already have collaborations on CEPC SRF technology and various SRF projects.
  - Future collaborations: SHINE and other CW SRF FEL projects in China.
- **CEPC SRF international collaboration**
  - Organization: TBD
  - Funding: apply for international team program (CAS Lu Jiaxi etc.) to support personal exchanges.
  - Activities: ILC/SuperKEKB (KEK), INFN-LASA, JLAB: SRF system design, technology and infrastructure, annual SRF collaboration meeting with KEK, personal exchanges.
  - Future collaborations: FCC-ee (CERN, Univ. Rostock), EIC (JLAB, BNL), PIP-II and LCLS-II-HE (FNAL), DESY, CEA-Saclay etc.

Jiyuan Zhai

IAC Recommendation 11

Key technologies of 10 GeV S-band linac baseline



- Electron gun (1)
- Positron source (1)
- SHBs (2)
- Buncher (1)
- S-band accelerating structure (279)
- Pulse compressor (74)
- Big hole accelerating structure (6)
- DR 650MHz RF cavity (2)
- ……

Jingru Zhang

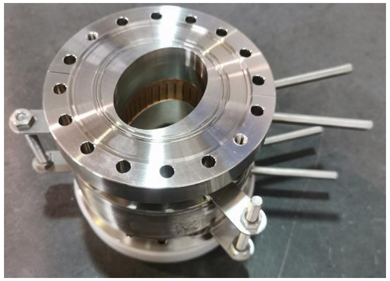
Cooperative manufacturers

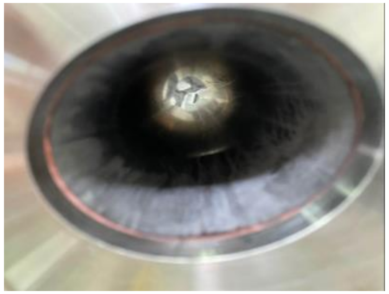
- Electron gun: Hanguang, Hubei
- SHBs: Keye, Hefei
- Buncher: GaoNengRuiXin, Beijing
- flux concentrator: KEK
- S-band accelerating structure design
  - GaoNengRuiXin, Beijing
  - The Twelfth Research Institute of China Electronics Technology Corporation
  - Potential international manufacturers: Mitsubishi (Japanese); Vitzro-Tech (Korea)
- Pulse compressor: GaoNengRuiXin, Beijing, Shanghai Hangye
- Damping ring RF cavity: Keye, Hefei

Response to IAC recommendation

3. Is the accelerator TDR on track? What should be improved and how to achieve the improvement?

- To answer the question of whether the TDR is ”on track”, its “goal” and time frame must be clearly stated consistently.
  - ✓ **The key components of vacuum system is vacuum pipe, RF shielding bellow and NEG coating, Which are being “on track”, and will reach those design goals. TDR of vacuum system will be finished by the end of 2022.**





Yongsheng Ma

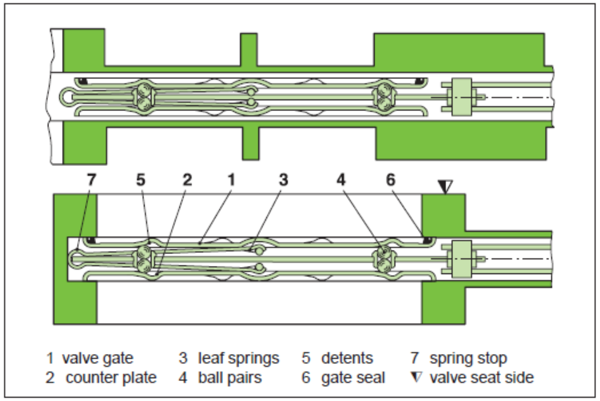
Response to IAC recommendation

Schedule:

2019/6	Complete the technology investigations and the preliminary designs of the dipoles vacuum chambers, RF bellows and NEG coating equipment.
2019/12	Complete the engineering drawings of the above components and equipment, carry out the investigation of RF all metal gate valves.
2020/6	Complete signing of the manufacture contracts of vacuum chambers, RF bellows. NEG coating experiments will be setup.
2020/12	The prototypes of the dipole vacuum chambers have been finished, medium-term examination goals： the ultimate pressure of the vacuum chambers is less than 3×10^{-10}Torr； the thermal outgassing rate is less than 5×10^{-12}Torr•L/s/cm^2.
2021/6	Carry out the 6m pipe NEG coating experiments and the measurements of samples. Surface treatment of 6m long will be optimized. Complete the fabrication and measurement of the RF bellows. The design specification of the contact pressure for RF contact fingers is 125$\pm$25g/finger.
2021/12	A 6m long NEG coating pumping speed test system will be built and tested.
2022/6	Complete the NEG coating of a 6m long copper vacuum chamber, reach the design specification with pumping speed of 200 L/s·m for the coating vacuum chamber
2022/12	Complete the project reviews, acceptance and documents archiving.

Response to IAC recommendation

- Draw up a list of components likely to require a second source, and identify potential international suppliers.
  - ✓ **All metal gate valves can only be supplied by VAT in globe, it need to require a second source. And others components can be supplied by different company in the world or China.**



Yongsheng Ma

Response to IAC recommendation 16

Recommendation 16:

- *Perform detailed simulation studies to better understand the physics needs from the detector at the various CEPC energy stages; draw consequences about the corresponding detector performance requirements (e.g. photon resolution, jet resolution, added value of PID) and study how this influences the detector design.*
- *Study the physics case for performing flavor physics including the tau lepton at the Z-peak. Draw conclusions on a possible impact on the detector design.*
- *Given that time-of-flight detectors with a time resolution in the 30-50 ps are becoming available, study their potential added value for a CEPC detector by assessing a few key physics benchmarks.*
- *Assess the added value of dE/dx capabilities in the tracker.*
- *Assess the added value of the muon detector system. As a result, define the number of muon detection layers to include, together with their required performance.*

Response to IAC recommendation 16

- Neutral Pion (photon…)

– ECAL impact on different benchmark analyzed

– Increasing the pi-0 reconstruction eff*purity from 30% to 50% at Z->qq sample once stochastic term improved from 15%/sqrt(E) to 5%/sqrt(E).

– Significantly depends on the process (abundance of photon) & pi-0 energy

– Benchmark physics channel analysis is needed

- Charged Kaon

– Decent Kaon id required, up to 20 GeV

– VTX, Momentum resolution & Pid: complementary to each other

– Preliminary: dE/dx of o(2%) will be needed. Cluster counting? Very aggressive though.

From the summary slide of Manqi's talk on CEPC DAY.

Response to IAC recommendation 16

- Leptons

– A solved problem for both isolated leptons and Jet lepton

– Taus, both isolated and inside jet, can be decently identified; further optimization is expected to improve the performance significantly;

- Jet

– BMR: standard, physics requirements, geometry dependence.

– Differential Jet response analyzed, confirming

    - Jet energy response (JER/JES) ~3 times better than LHC experiments;
    - W mass could be measured ~ o(10) MeV using Higgs run data

– Jet Clustering is essential

- Several Flavor Physics benchmarks are processing as the Snowmass LoIs. One is submitted; others need ~1 year to converge.

From the summary slide of
Manqi's talk on CEPC DAY.

Request from IAC to consider the top threshold running at CEPC

- The target accuracy of e^+e^- for top mass measurement is O(10) MeV and in a model independent way with Luminosity around 200-400 fb^{-1}
  - with optimized setup: ~ 1 year of running (~480 fb^{-1}/year)
- Considering the run for top coupling measurement at CEPC, 360 GeV should be safe.
  - Need to investigate the feasibility of running with a lower energy.
  - The expected precision for the coupling is much better than LHC.
  - 2 ab^{-1} lum corresponds to 4-5 years with optimized setup.
- 360 GeV run is helpful for the Higgs width measurement.
  - The results are not much different from the running of 365 GeV.
- Some thoughts of new physics with 360 GeV are addressed.

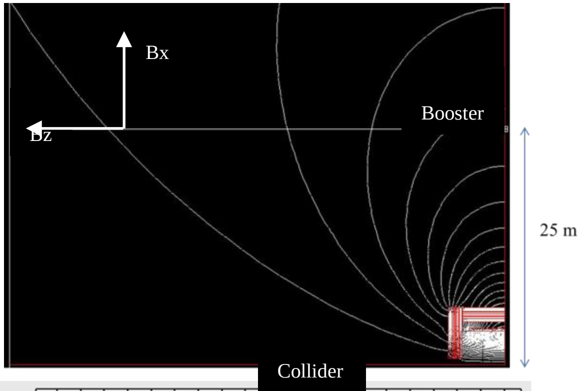
From Yaquan's talk on CEPC DAY

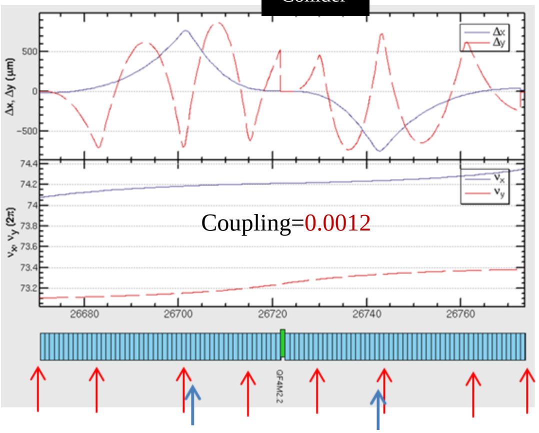
Impacts/solution of Detector Stray Field

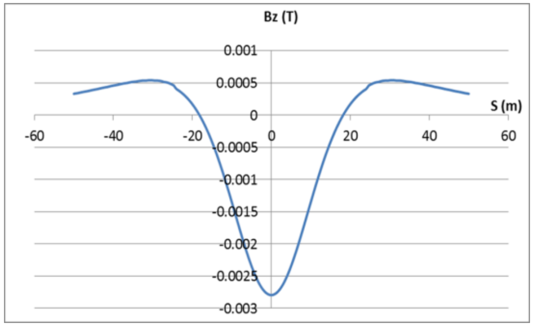
- *Continue to pursue studies of the solenoid yoke in view of magnetic stray fields and their influence on the booster beams and on other surrounding equipment.*

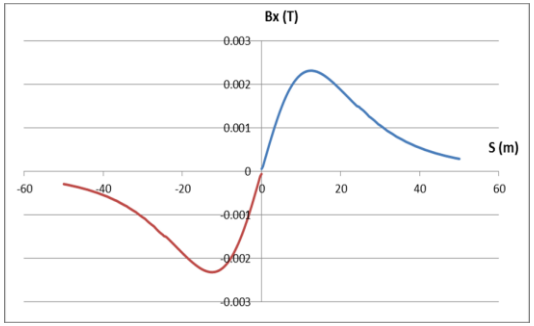
D. Wang, Y. Zhang, D. H. Ji

- Bz=28Gs Bx=23Gs By=2.3 Gs
  - Longitudinal field is modeled as solenoid.
  - Transverse field is modeled as dipoles.
  - 100 slices (-50m ~ 50m): simulate the real distribution of detector field.
- Beam dynamics effects of detector field is strongest at **10 GeV**.
- Vertical orbit distortion due to Bx is dominant effect.
- Local orbit correction is essential (8 v correctors+ 2 h correctors)
- No influence to booster DA after orbit correction @10GeV
- Extra SR loss < 1%, critical energy <10% @(180GeV)









Response to IAC recommendation 17

Recommendation 17:

- *Set up a logical structure in Indico for specialized meetings (e.g. for specific sub-detectors, software development, detector design and engineering, physics studies, etc.). Schedule regular meetings among experts.*
- *Set up a system of internal technical notes, as well as a corresponding internal reviewing process.*
- *Set up a system for reviewing/rehearsing public CEPC presentations.*
- *Set up a (simple) structured public web page / work space where links to working groups, meetings, technical documents, software documentation, public presentations etc. can be found. Include instructions for joining the corresponding mailing lists.*

Response to IAC recommendation 17

CEPC accelerator documents management

- Documents management for CEPC accelerator at present is mainly based on a professional software--ProjectWise.
- A LAN cache server is located at IHEP for fast network speed. Then LAN cache server can be communicated with the main servers.
- Two catalogues were set up for different kinds of CEPC accelerator files, such as technical documents, 3D models of accelerator partials, and so on.

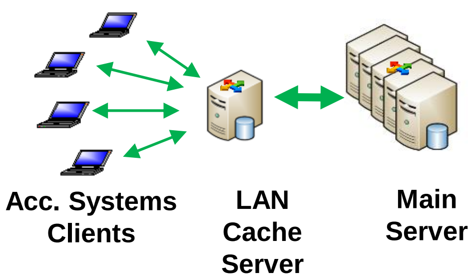


Fig. 1. CEPC accelerator documents storage

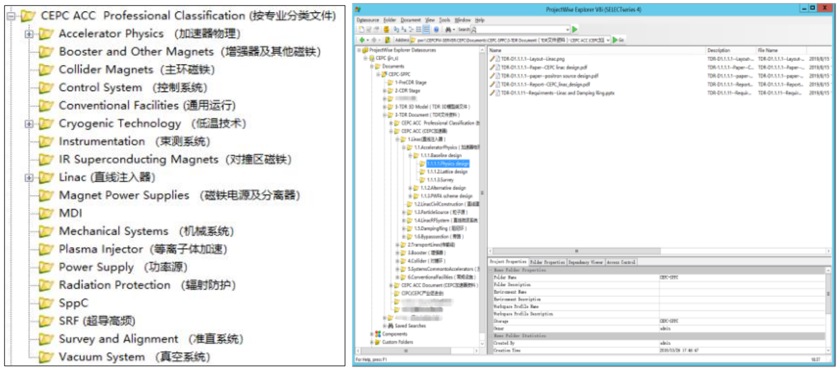
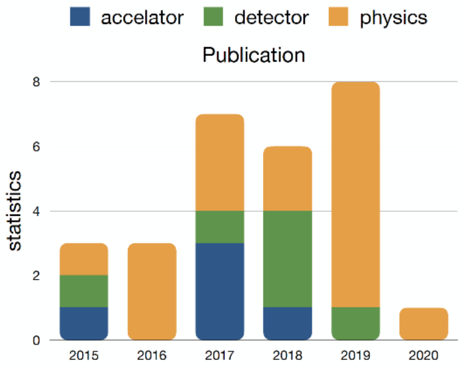
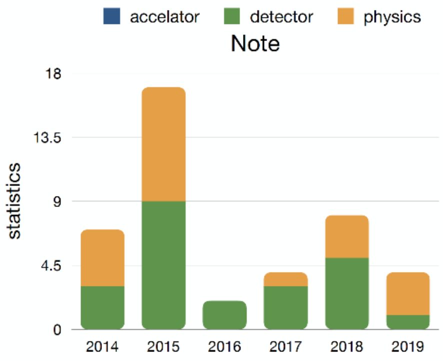


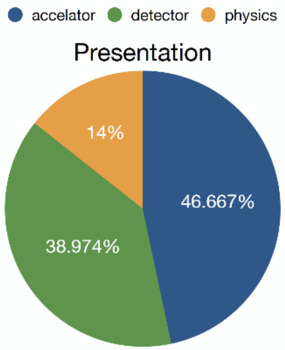
Fig. 2. Two catalogues were set: (left) classified in accelerator system; (right) classified in CEPC accelerator structure.

Response to IAC recommendation 17

CEPC Documentation







- Established in 2016, Up to now:
  - Public: 195 presentations, 28 publications, 18 Snowmass LoIs (Accessible without Docdb account)
  - Protected: 41 internal notes

Summary

- CEPC accelerator - high luminosity design and TDR are moving ahead.
- Guided by IAC and Review committees accelerator/detector R&D making significant progress.
- The CEPC Study Group continues with the site investigation, experimental hall design, and MDI study.
- CEPC is strengthening and broadening the cooperation with industrial partners;
- Continuing with international collaboration; participating in the HEP strategy planning process in Europe and the US.
- Implementaion of 2019 IAC recommendations

IAC Recommendation 8 and IARC 11-2

CEPC SRF Parameter Comparison

	BEPCII 500 MHz 4.2 K	**BEPC3** 500 MHz 4.2 K	**CEPC CDR H** 30 MW 3E34	**CEPC CDR Z** 16.5 MW 32E34	**CEPC 1-cell H** 30 MW 3E34	**CEPC TDR Z** 30 MW 100E34	**CEPC TDR H** 30 MW 3E34	**CEPC TDR W** 30 MW 10E34	**CEPC Ultimate Z 50 MW 167E34**
Beam current (mA)	400 (600)	900	2 x 17.4	460	2 x 17.4	**838**	2 x 17.4	2 x 87.7	1400
Cell number	1	1	2		1	1	2/1	2/1	1
Cavity number / ring	1	2	2 x 120	60	2 x 120	60	2x(90+60)	2x(90+60)	60
Eacc (MV/m)	6 (1.5 MV)	10 (2.5 MV)	**19.7**	3.6	**40**	**9.4**	**19.7**	4.2	9.4
Q_0 @ 4.2 K / 2 K	1E9	1E9	**1.5E10**	1.5E10	**3E10**	**1.5E10**	**1.5E10**	1.5E10	1.5E10
Total wall loss (kW)			6.1	0.1	6.1	0.35	6.1	0.27	0.35
Input power (kW)	110	150	250	275	250	**500**	250/125	250/125	**835**
Cavity# / klystron	1	1 SSA	2		2/1	1	2/1	2/1	1
Klystron power (kW)	250	150 SSA	800	800	800	800	800	800	1200
Total KLY number	2	4	120		60+120	120	90+120	90+120	120
HOM damper	Absorber	Absorber	Hook+ Absorber		Hook+ Absorber	Absorber	Hook+ Absorber	Hook+ Absorber	Absorber
HOM power (kW)	8*	20	0.6	1.9	0.23	2.4	0.46 / 0.23	**1.5** / 0.75	**4**

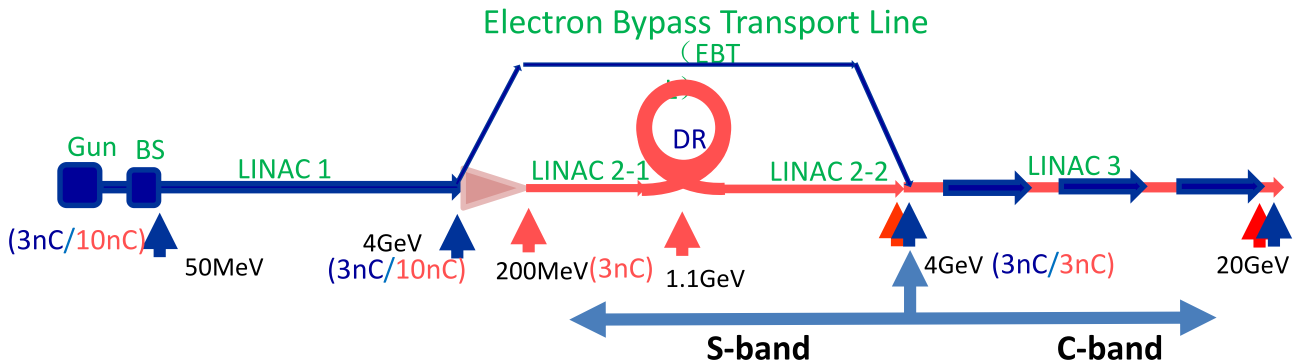
* Bunch length 15 mm, cavity cell HOM loss factor 0.1 V/pC, tapers 0.06 V/pC, absorbers 0.26 V/pC.

Jiyuan Zhai

IAC Recommendation 11

Build **international and domestic collaborations** in several critical areas, e.g., MDI, SC-RF, polarization, beam dynamics (beam-beam, dynamic aperture, etc.), **C-band linac**, and RF sources.

- Linac alternative design
  - IAC Recommendation: Higher energy injection into the booster with a longer linac
    - Reduce the difficulty of the booster design
    - Reduce the technical risk of low magnetic field magnets of the booster
- 20 GeV S-band+C-band RF system
  - Meeting the requirement of the booster (C. Meng)
  - C-band start energy: 4GeV
  - The total length is about 1.4 km, 200 m longer than the baseline design



Jingru Zhang