China Industry Status

J. Gao

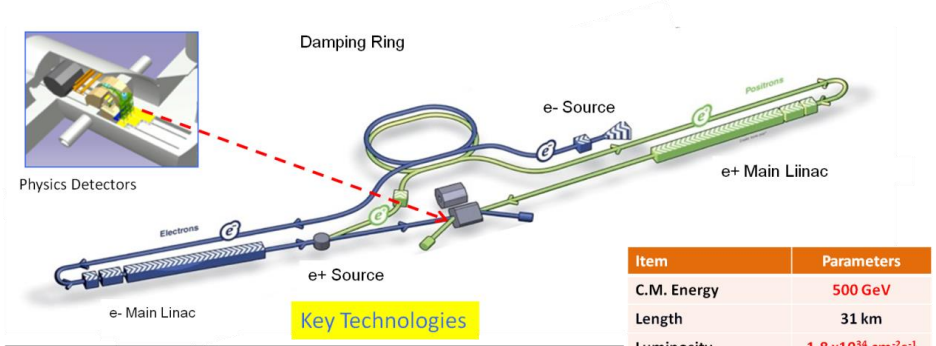
Institute of High Energy Physics

International Workshop on Future Linear Colliders

LCWS2019, Sendai, Japan

Oct. 28-Nov. 1, 2019

China ILC Collabration



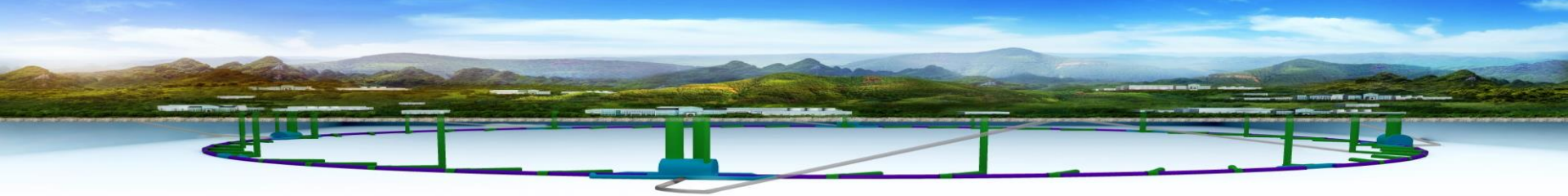
Item	Parameters
C.M. Energy	500 GeV
Length	31 km
Luminosity	1.8×10^{34} cm^{-2}s^{-1}
Repetition	5 Hz
Beam Pulse Period	0.73 ms
Beam Current	5.8 mA
Beam size (y) at FF	5.9 nm
SRF Cavity G. Q_0	31.5 MV/m $Q_0 = 1 \times 10^{10}$

China has been working ILC collaboration since 2005 as ILC GDE member (IHEP)

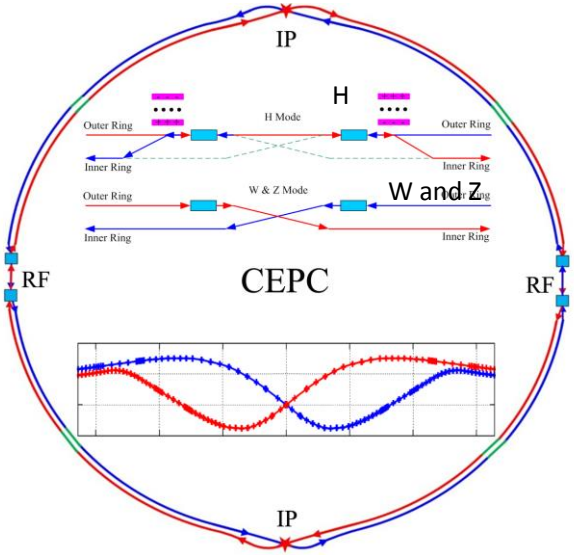
ILC 500GeV needs ~16000 1.3GHz 9cell cavitites

Since 2017

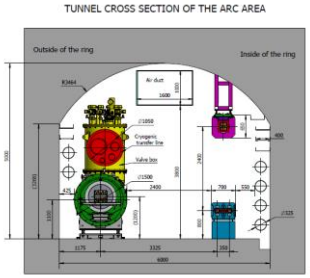
ILC 250GeV Higgs factory needs ~8000 1.3GHz 9cell cavitites

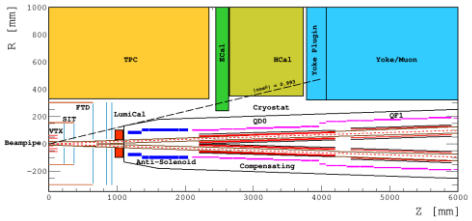


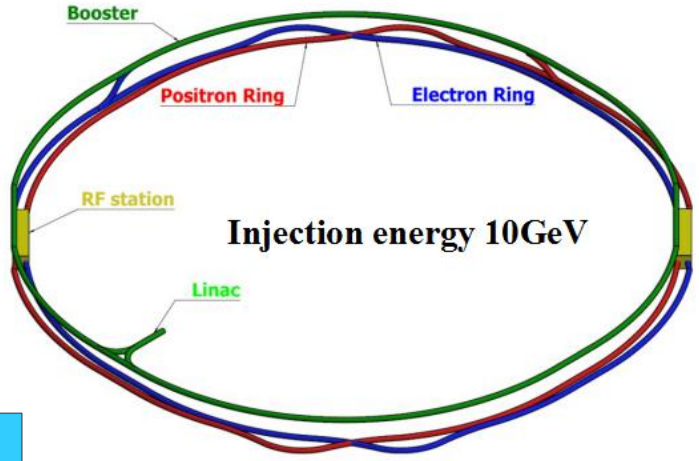
CEPC CDR Baseline Layout



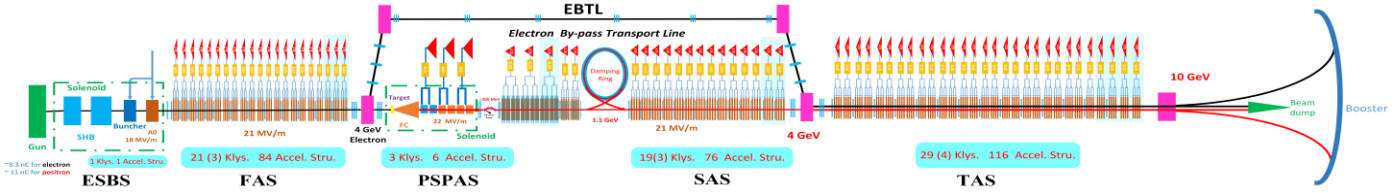
CEPC collider ring (100km)







CEPC booster ring (100km)



CEPC Linac injector (1.2km, 10GeV)

CEPC Industrial Promotion Consortium (CIPC) Collaboration Status

Established in Nov. 7 , 2017
CIPC Annual Meeting, July 26 , 2018

1) Superconduting materials (for cavity and for magnets)
2) Superconductiong cavities
3) Cryomodules
4) Cryogenics
5) Klystrons
6) Vacuum technologies
7) Electronics
8) SRF
9) Power sources
10) Civil engineering
11) Precise machinary.....

Now:
-Huanghe Company,Huadong Engineering Cooperation Company,on CEPC civil engineering design, site selection, implementation...
-Shenyang Huiyu Company on CEPC MDI mechanical connection design
-Zhongxin Heavy Industry on Elecletric-magnetic seperator design
-China Astronotics Department 508 Institute on CEPC MDIsupporting design and CEPC magnets mechanical designs...
-Kuanshan Guoli on CEPC 650MHz high efficiency klystron
-Huadong Engineering Cooperation Company,on CEPC alignement and installation logistics...

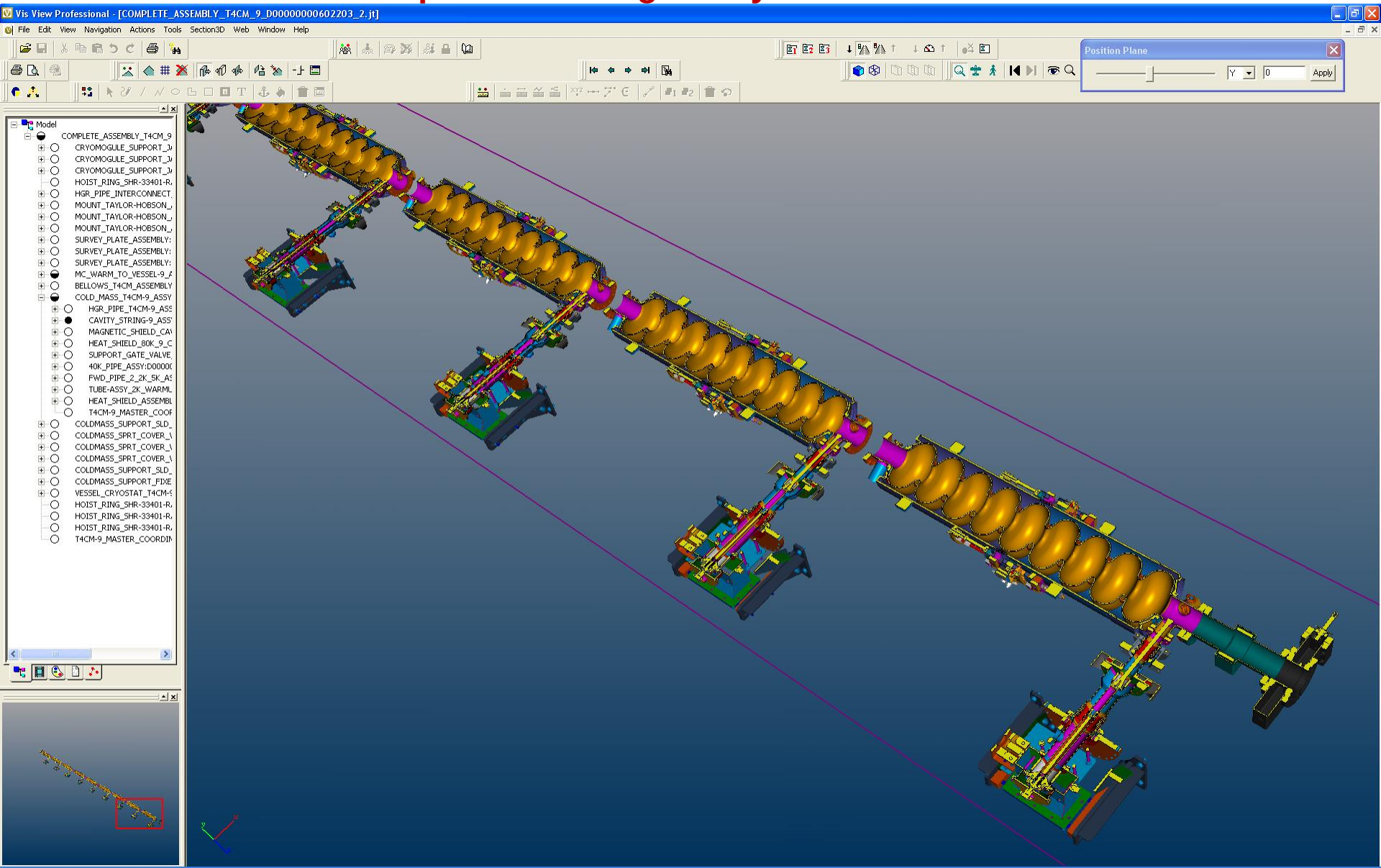
Ningxia Orient Tantalum Industrial Co.,Ltd.

OTIC SCRF Activities and Industrialization

SC Cavities in a Superconducting Accelerator such as in ILC, CEPC booster and XFELs

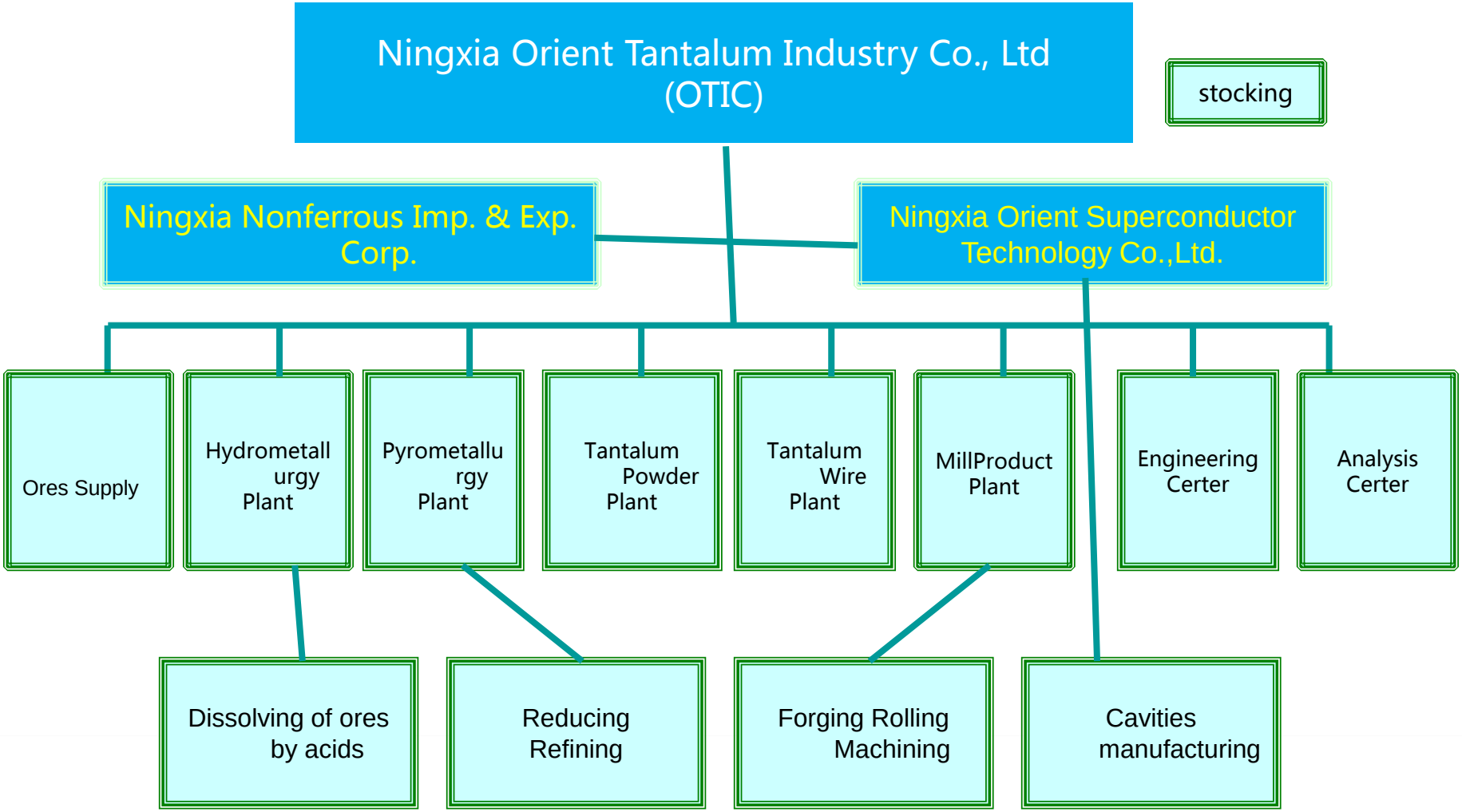
东方钽业 OTIC
中国有色集团成员企业

1.3GHz 9-cell Superconducting Cavity in Linear Accelerator



Brief Introduction of OTIC

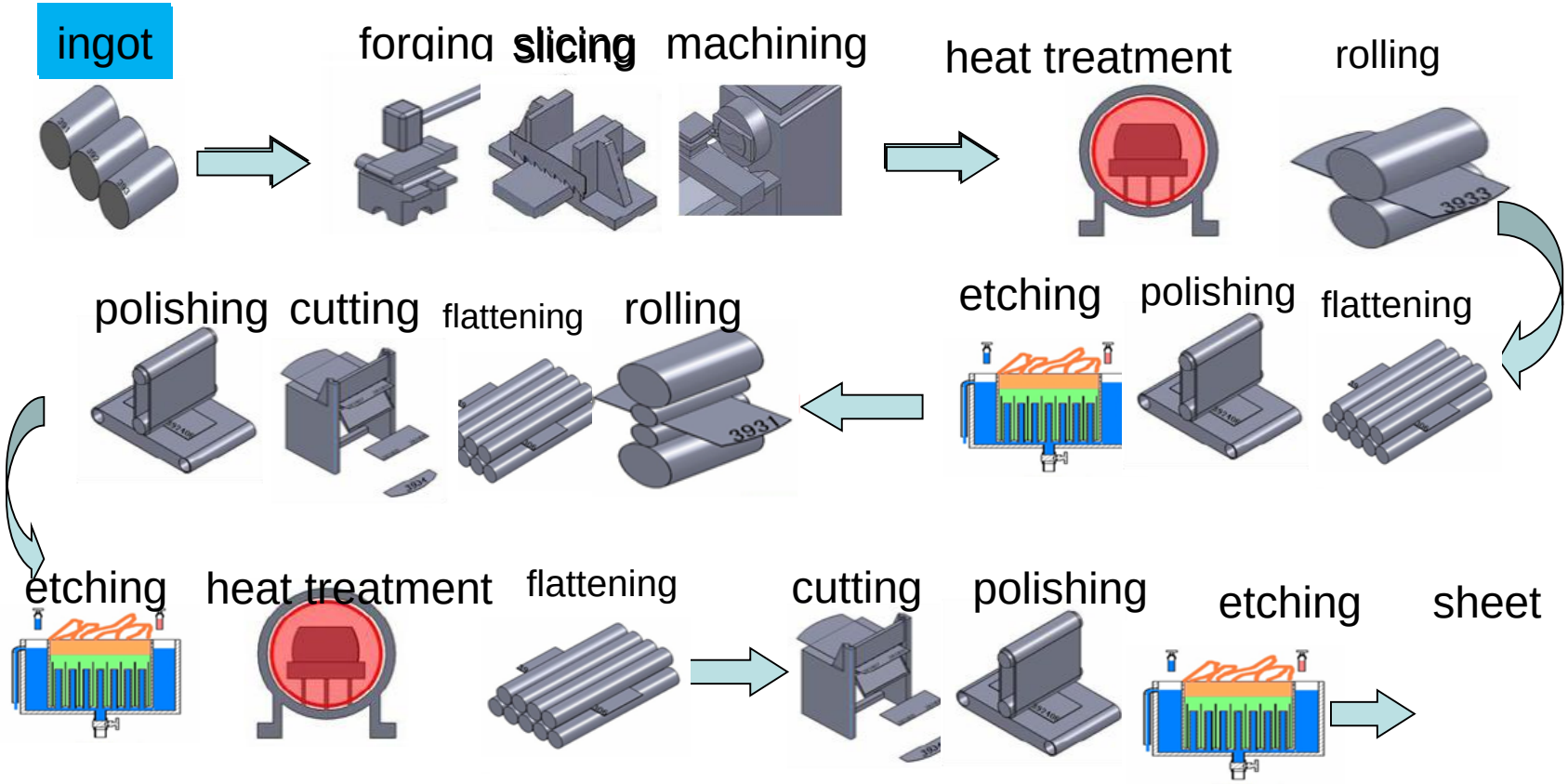
东方钽业 OTIC
中国有色集团成员企业



Brief Introduction of OTIC

东方钽业 OTIC
中国有色集团成员企业

Process Flow of Nb-sheet for Cavity



Brief Introduction of OTIC

Capacity

Products	Annual capacity	Spec.
RRR Nb sheet	30 Tons	RRR40, RRR250, RRR300
RRR Nb tube	5 Tons	RRR40, RRR250, RRR300
RRR Nb rod	10 Tons	RRR40, RRR250, RRR300

Brief Introduction of OTIC

东方钽业 OTIC
中国有色集团成员企业

Achievements

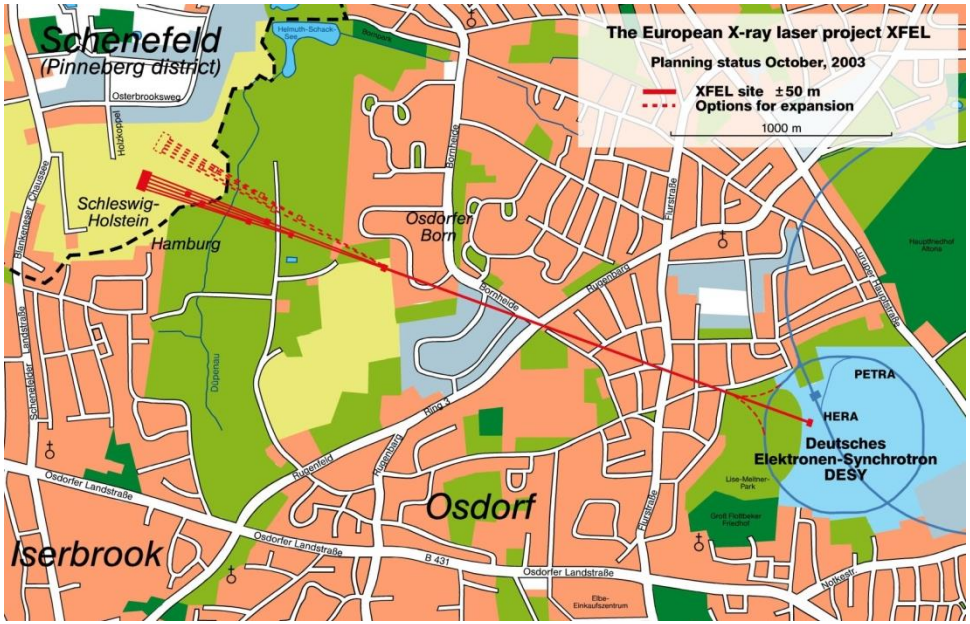
On-site inspection by INFN

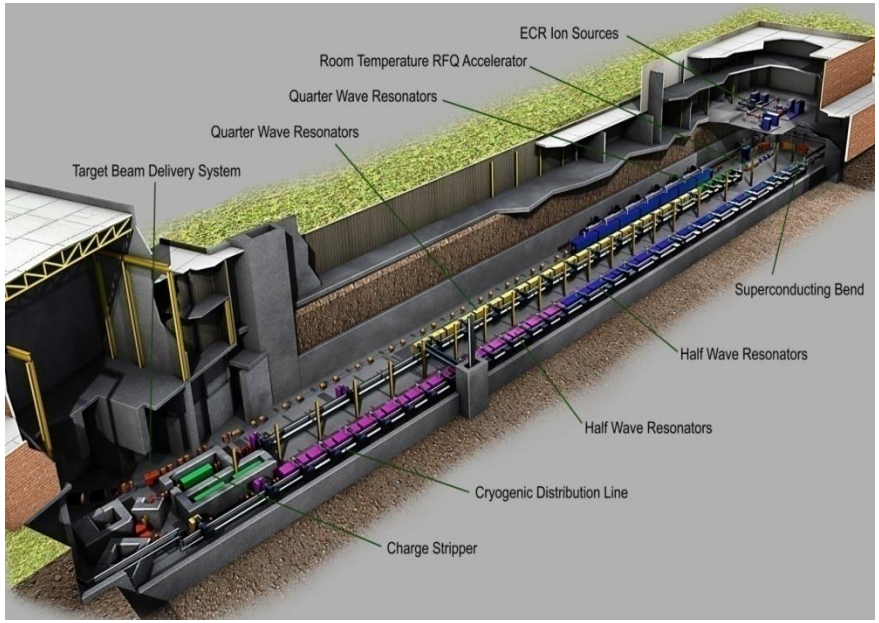
On-site inspection by SHINE

Brief Introduction of OTIC

3.4km

Achievements





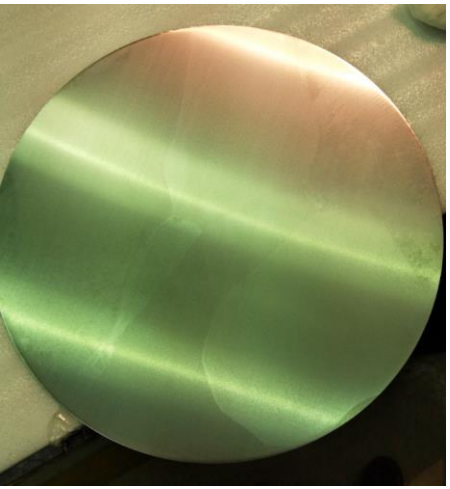
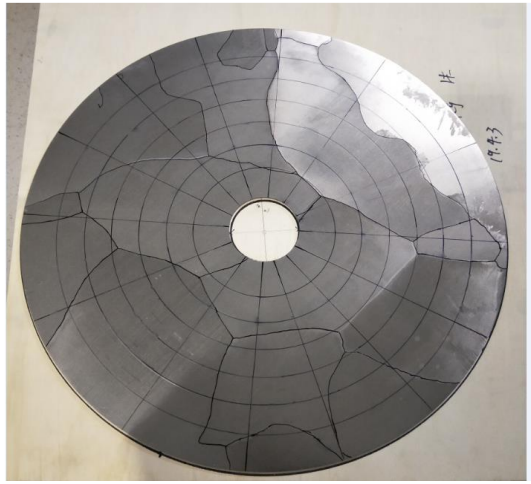
2011 DESY – XFEL: 8 tons RRR300 Nb sheets, 30% of the project

2012 Michigan State University – FRIB: 8.5 tons RRR250 Nb sheets, 70% of the project

2014 Fermilab - LCLS II: 5 tons RRR300 Nb sheets, 50% of the project

2017 INFN & STFC – ESS: 10 tons RRR300 Nb sheets, 100% of the project

Study and manufacture for SCRF

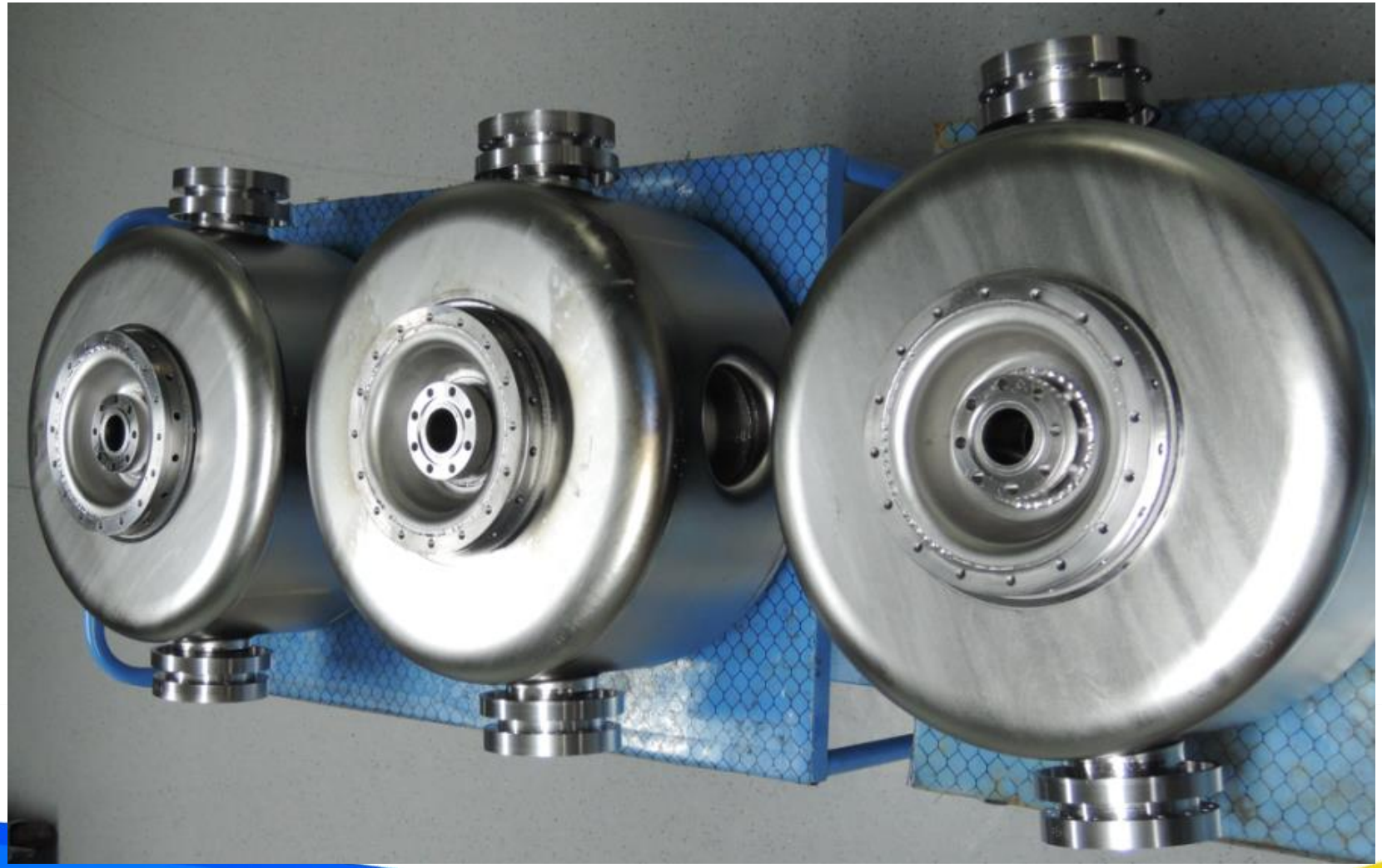




The maximum diameter of RRR300 Nb disc with large grain at OTIC can be machined to Φ540mm, which can meet the manufacturing requirement of CEPC 650MHz superconducting cavity.
At present, large-scale Nb material with large grain is being supplied to Shanghai Hard X-ray Big Science Facility.

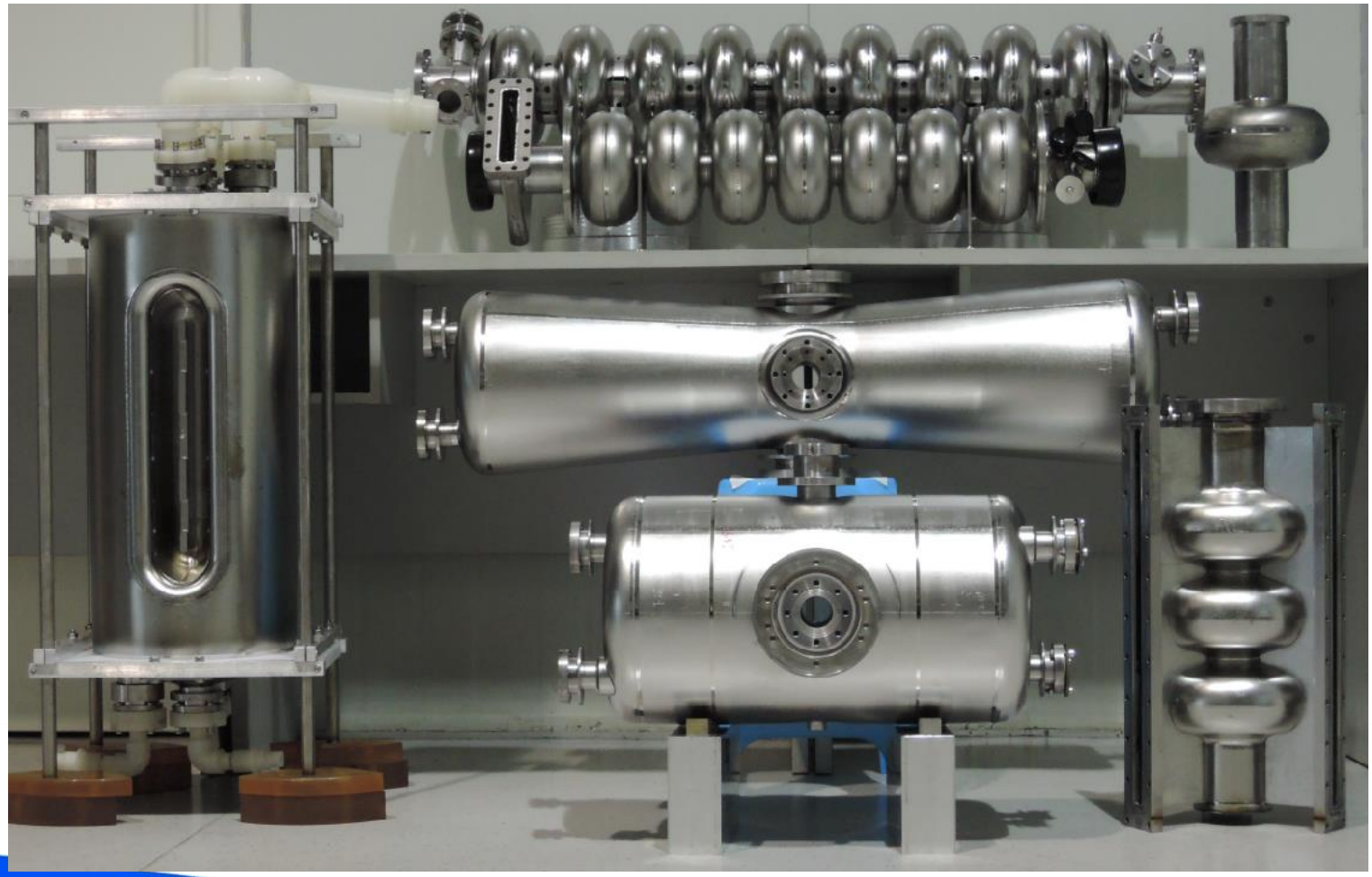
Large grain Nb disc and cavity manufacture

Study and manufacture for SCRF

东方钽业 OTIC
中国有色集团成员企业

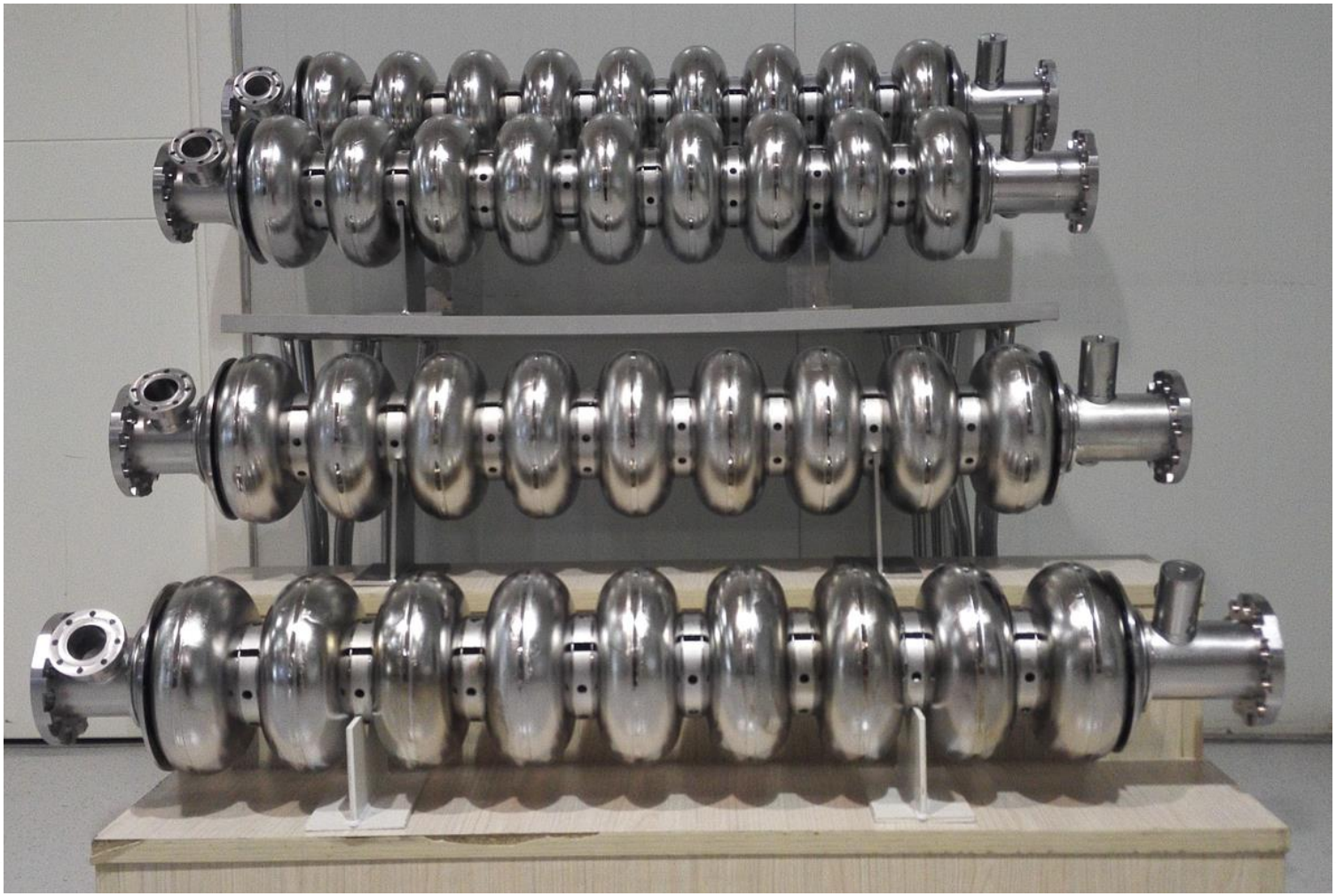


Collaboration with main Agencies



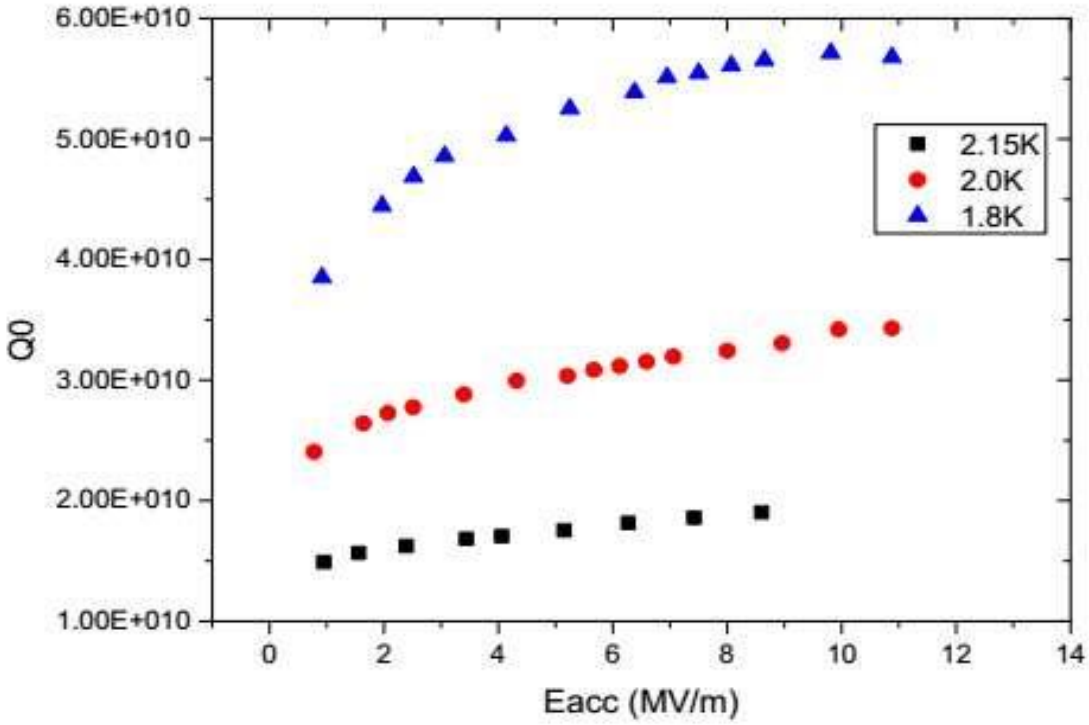
Collaboration with main Agencies

东方钽业 OTIC
中国有色集团成员企业



1.3GHz 9cell large grain superconductor cavities

Study and manufacture for SCRF



N-doping in Peking University
1.3GHz large grain single cell cavity

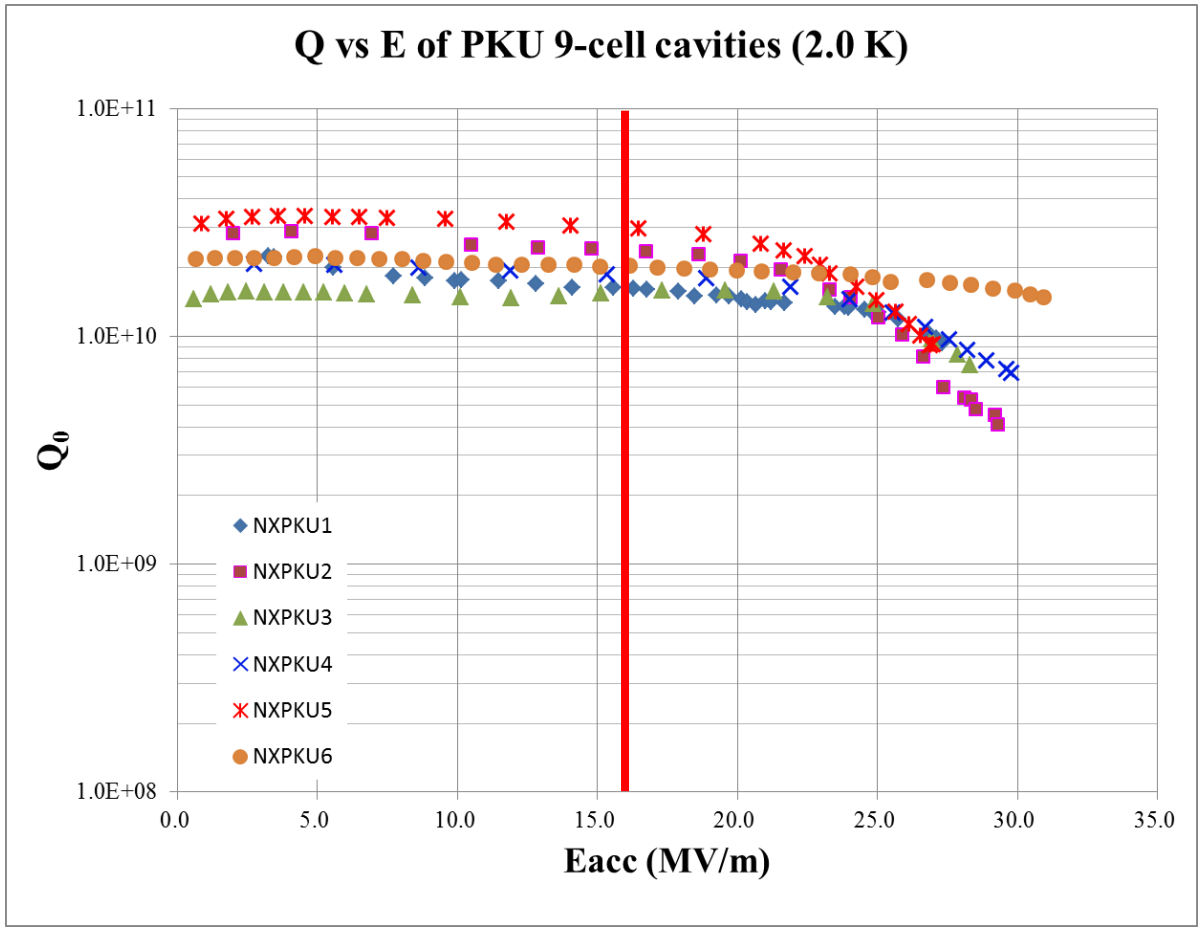
In cooperation with IHEP and Peking University, OTIC established BCP and HPR post-processing facilities, improved nitrogen doping process and EP facilities, and possessed the capability of post-processing of superconducting cavity in the first half of 2019.

Study and manufacture for SCRF

东方钽业 OTIC
中国有色集团成员企业

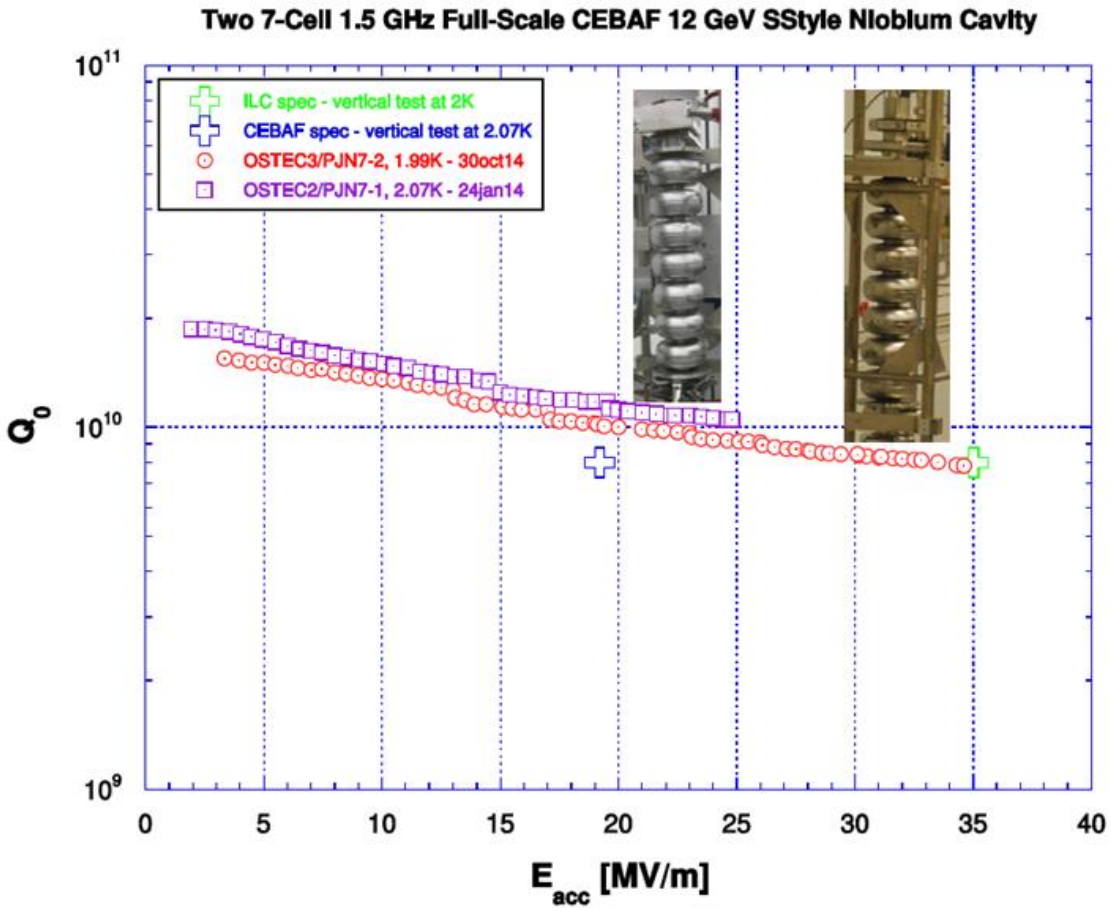
1. E_{acc} of all 6 cavities larger than 25 MV/m
2. Q_0~1.6-2.4E10 @ 16 MV/m

#3, 2nd test (Sept. 2017), with additional BCP &HPR



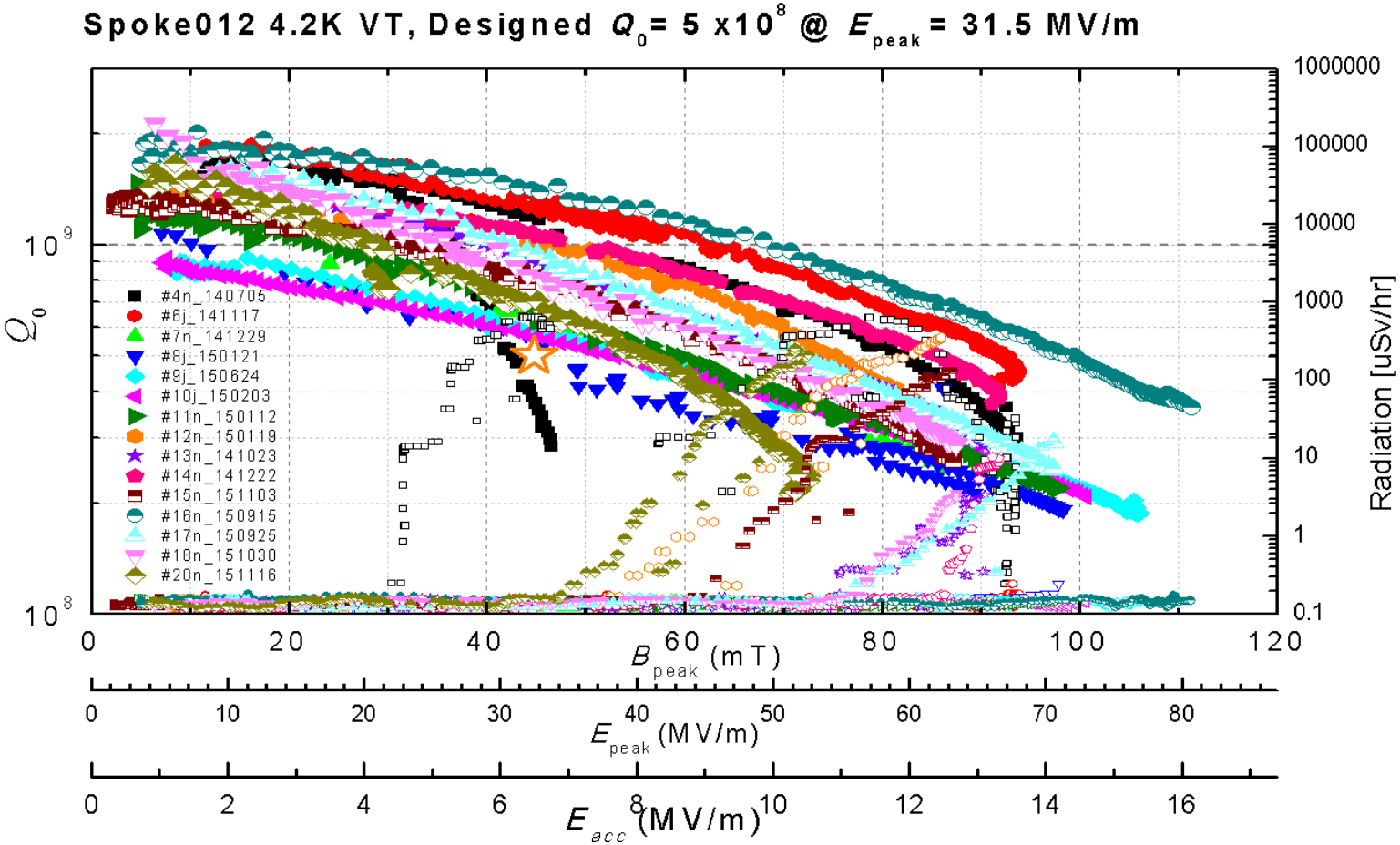
VT result for 6 9-cell large grain cavities after BCP & HPR

Study and manufacture for SCRF



In 2013, OTIC cooperated with Jlab for the first time to develop a 1.5GHz 7-cell superconducting cavity for CEBAF upgrade. Superconducting cavity was tested at 2K low temperature and the acceleration gradient reached 36MV/m. It was the first time for OTIC to have the manufacturing capability of superconducting cavity.

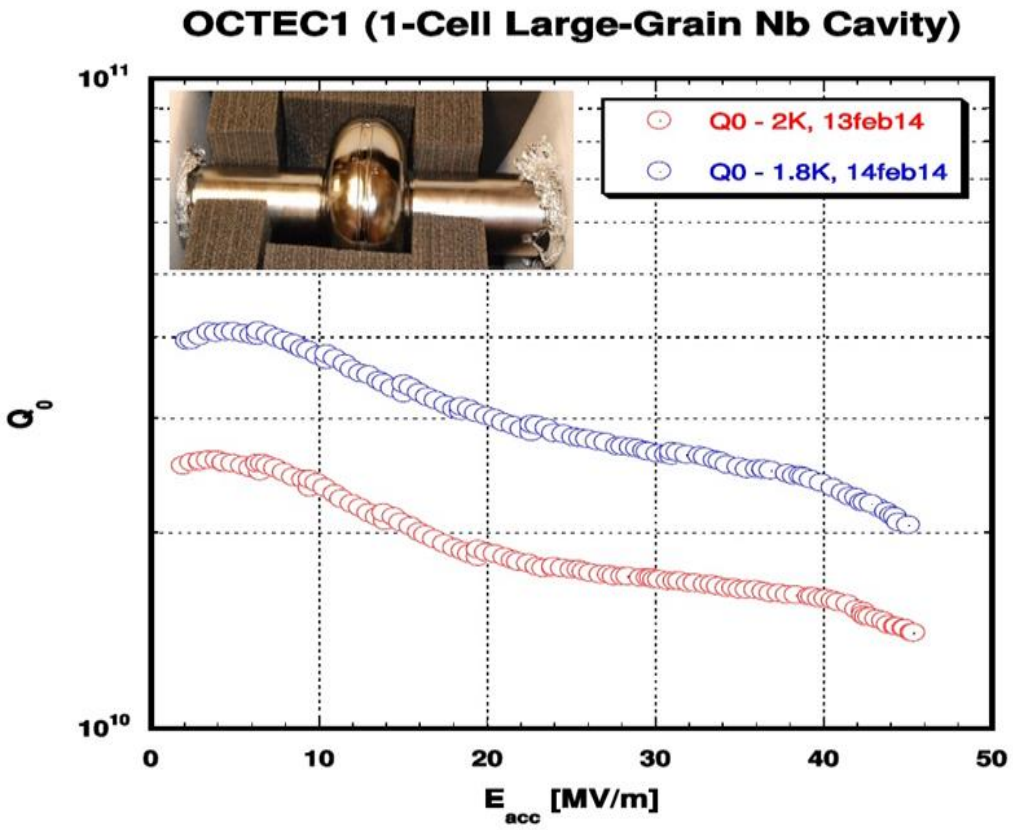
Study and manufacture for SCRF



21 SPOKE012 cavities for IHEP, #14-#18 were manafactured by OTIC.

Study and manufacture for SCRF

First superconducting niobium cavity built by OSTEC. Maximum gradient 46 MV/m with excellent Q0



Prior history since last test on November 4, 2013:
electropolishing for 30 micron removal followed by baking at 120 degree Celsius for 18 hours

1.5GHz large grain single cell superconducting Nb cavity, its maximum acceleration gradient reached 46MV/m. It was the first Nb cavity which was manufactured in OTIC in 2013.

Results of 1.5GHz large grain single cell superconductor cavity

Beijing HE-Racing Technology Co., Ltd.

北京高能锐新科技有限责任公司

Beijing HE-Racing Technology Co., Ltd.

IHEP New SC Lab under Construction （Status August 2019)

New SC Lab Design (4500m^2)

Bird view in August 2019

Experimental hall

Hellium recirculating tanks

2.5KW@4.5Kcold box

2K JT heat exchanger

SC cavity production factory with facilities (Beijing branch)

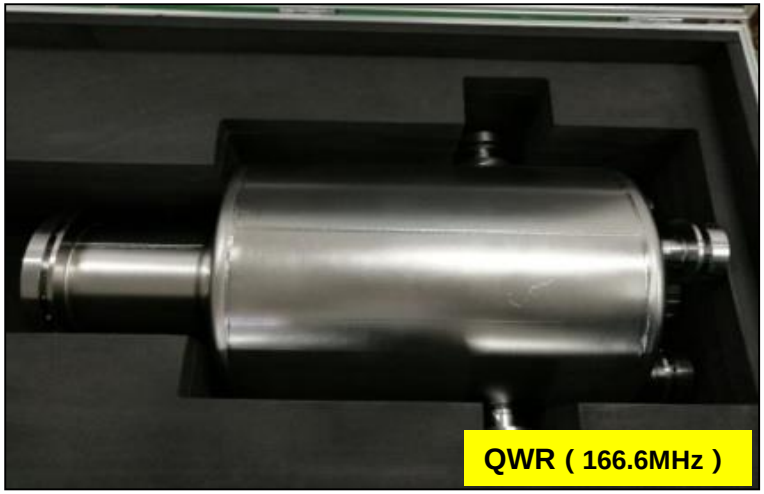
SC Cavity Production History

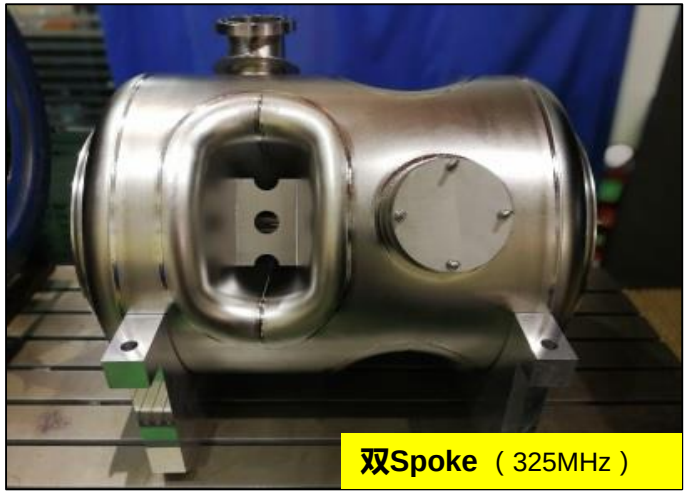
SC Cavity Product Parameters

8 types , 4frequencies , totally 39 pieces

No.	Facility	SC cavity type	Frequncy (MHz)	Number (piece)	E (MV/m)	Status
1	HEPS-TF	QWR	166.7	2	29	Vertical test
2	C-ADS	Spoke，β=0.12	325	4	11.5	Operation with beam
3	C-ADS	Spoke，β=0.21	325	5	12	Operation with beam
4	C-ADS	Spoke，β=0.24	325	1	11.2	Vertical test
5	C-ADS	双Spoke，	325	1	/	Waiting vert. test
6	CEPC	2 cell 椭球腔	650	1	24	Vertical test
7	CEPC	5 cell 椭球腔	650	1	12	Vertical test（4K）
8	PAPS	2 Cell 椭球腔	650	3	/	Waiting vert.test
9	PAPS	单cell 椭球腔	1300	10	36	Vertical test
10	ILC R&D	9 cell 椭球腔	1300	1	24	Vertical test
11	PAPS	9 cell 椭球腔	1300	2	25	Vertical test
12	SHINE	9 cell 椭球腔	1300	8	25	Vertical test（4 ）

SC Cavities（ Photos ）


QWR (166.6MHz)

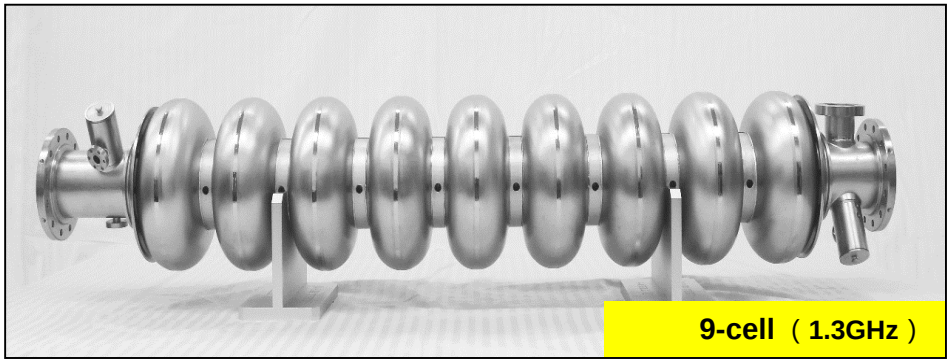

双Spoke （ 325MHz ）


Spoke 012 （ 325MHz ）


Spoke 021 （ 325MHz ）

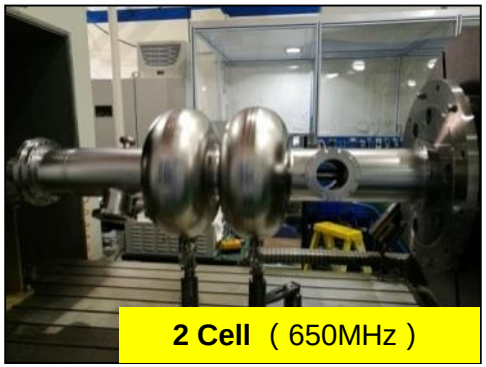

Spoke 024 （ 325MHz ）

SC Cavities（ Photos ）

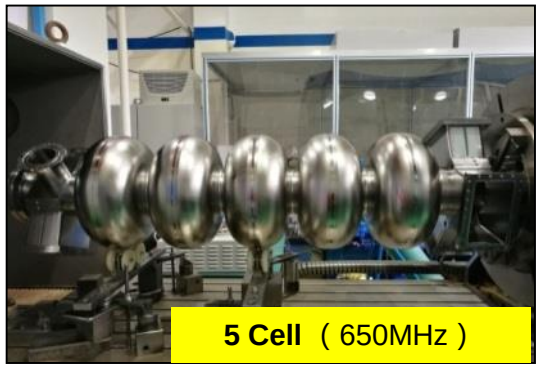


9-cell （ 1.3GHz ）

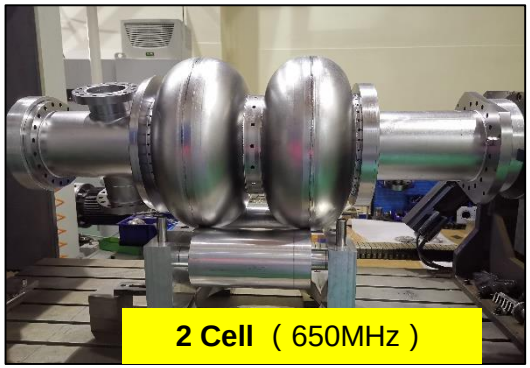
9-cell with Helium Vessel （ 1.3GHz ）



2 Cell （ 650MHz ）

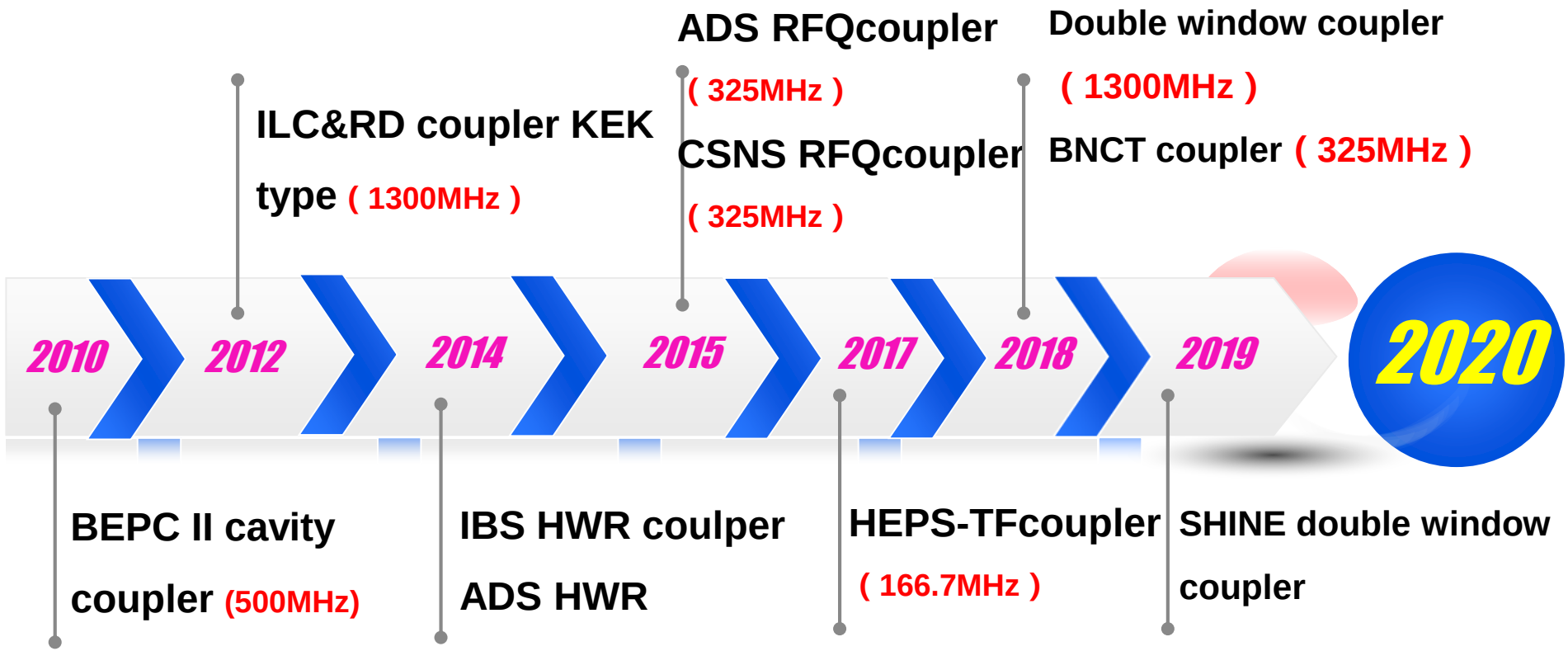


5 Cell （ 650MHz ）



2 Cell （ 650MHz ）

Couper R&D(History)



Coupler（Parameters）

12types，6frequencies， total 50piece

No.	Facility	Type	Freq. (MHz)	Cupler type	Num.	Power (kW)	Status
1	IBS	HWR (SCC)	162.5	Coaxial	2	Test: CW, 15 kW	Test
2	C-ADS	HWR (SCC)	162.5	Coaxial	2	Oper: CW,80 kW	Oper
3	HEPS-TF	QWR (SCC)	166.7	Coaxial	2	/	Test
4	C-ADS	RFQ (NC)	325	Coaxial	8	Test: CW,105 kW Oper: CW,100 kW	Oper
5	C-ADS	Spoke (SCC) β=0.12	325	Coaxial	7	Test: CW, 10 kW Oper: CW, 10 kW	Oper
6	C-ADS	Buncher (NC)	325	Coaxial	3	/	Oper
7	CSNS	RFQ (NC)	325	Coaxial	5	/	Oper
8	BNCT	RFQ (NC)	325	Coaxial	5	/	Oper
9	BEPCII	1 cell (SCC)	500	Coaxial	4	Test: CW,420 kW Oper: CW,150 kW	Oper
10	PAPS	2Ccell (SCC)	650	Adjustable,single window	2	/	R&D
11	ILC R&D	9cell (SCC)	1300	Adjustable,double window	2	Oper: CW,70 kW	Test
12	SHINE	9cell (SCC)	1300	Adjustable,double window	8	/	Waiting test

Couplers（Normal conducting）

BEPC II（500MHz）

ADS（325MHz）

CSNS 聚束腔（325MHz）

CSNS RFQ腔（325MHz）

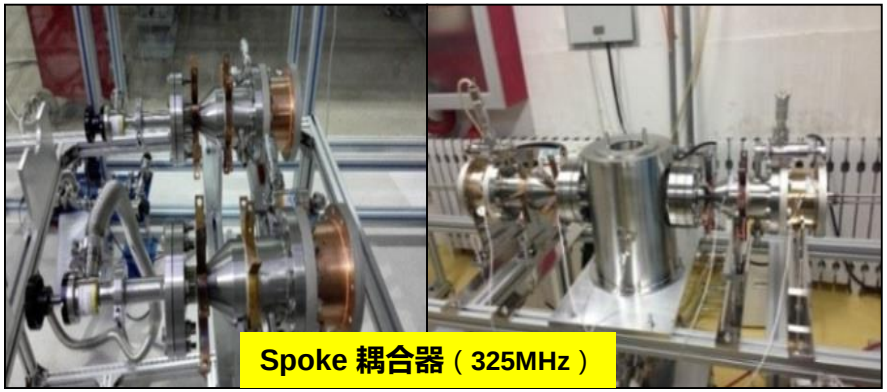
BNC耦合器（325MHz）

Coupler（SC coupler）

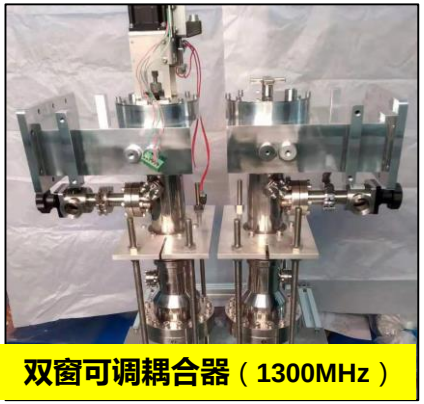

HWR 耦合器（162.5MHz）


QWR 耦合器（162.5MHz）


双窗可调耦合器（1300MHz）


Spoke 耦合器（325MHz）


双窗可调耦合器（1300MHz）


双窗可调耦合器（1300MHz）

ChaoGao Zhuang (zhongshan) Scientific Technology Co., Ltd.

和超高装（中山）科技有限公司

1.3G SC cavities

haoGao Zhuang (zhongshan) Scientific Technology Co., Ltd.

和超高装（中山）科技有限公司

25MeV连续波超导质子直线加速器（二）

Completed 7 types and 60 pieces

Nb SCCavities

1.3G-TESLA3+1/2Cell Cavity

1.3G-TESLA9Cell Cavity

325M-Spoke012 Cav162.5M-HWRCavity

500M single Cell Cavity

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Beijing Sinoscience Fullcryo Technology Co., Ltd.

中科富海 FULLCRYO

Aims to promote the industrial application of cryogenic technologies coming from TIPC

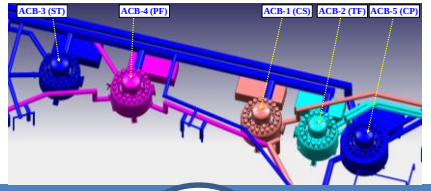
- Founded in August 2016 with a registered capital of RMB 131 million.
- High-tech company based on the cryo-technologies coming from TIPC, CAS
- Focus on Cryogenic Engineering

CEPC18KW@4K Cryogenics and System :

Milestone of Domestic Cryogenic activities

1959 Initial helium liquefaction

1976 Helium cryogenic system of KM-4



2008 Distribution valve boxes for "ITER" large-scale cryogenic system ; PKU-FEL 2K cryogenic system

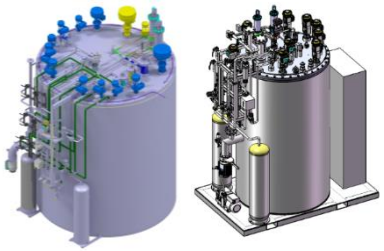
2012 2kW@20K helium refrigerator

2013 Participated in "SSRF" cryogenic system construction

2015 40L/h helium liquefier

1000W@4.5K helium refrigerator ; 10000W@4.5K helium refrigerator

2018 1000L/h H2 liquefier 200W@4.5K helium refrigerator for NFRI



2017 250W@4.5K helium refrigerator

20 Participated in "BEPC II" cryogenic system construction

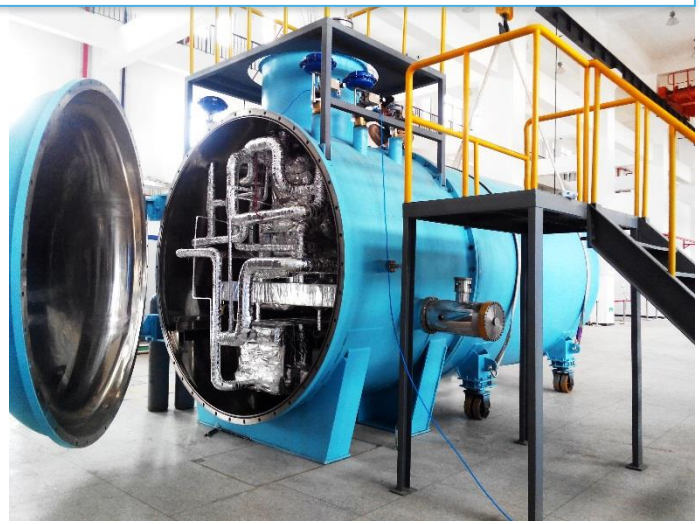
2019 2500W@4.5K & 500W@2K helium refrigerator; 500W@4.5K helium refrigerator

2020

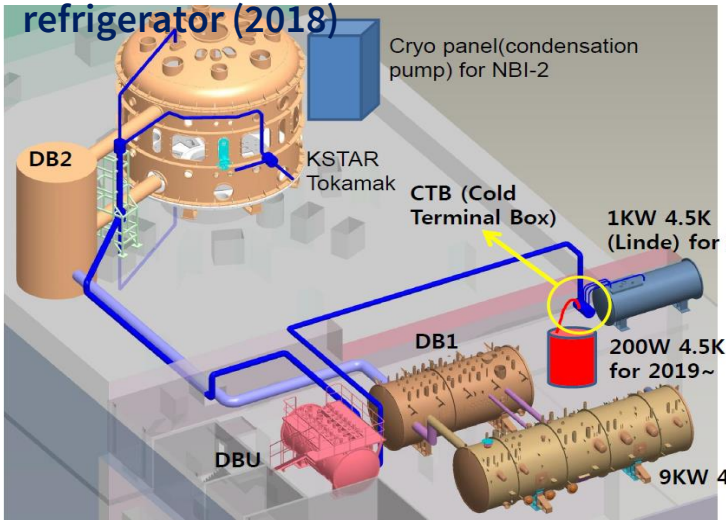
2023 18000W@4.5K helium refrigerator

Application

Successful operation of 10kW@20K refrigerator(2014)



Providing Korea National Fusion Research Institute（NFRI） with a 200W@4.5K helium refrigerator (2018)



Successful operation of 250W@4.5K refrigerator (2017)

Successful application of 40L/h LHe liquefier (2016)

Wuxi Creative Technologies Co.,ltd

WuXi Creative Technoloies Co. Ltd. (WXCX）

WXCX

Wuxi Creative Technologies Co.,Ltd(WXCX) is a professional manufacturer in Cryomodule Vacuum Vessel, Cryogenics system, Cryomodule Transfer Lines Sections, Indoor environmental simulator chambers and general precision machining parts.

WXCX holds ISO9001 Certification, ASME Vessel manufacture certificate, NBBI certificate, as well as European Pressure Equipment certificate.

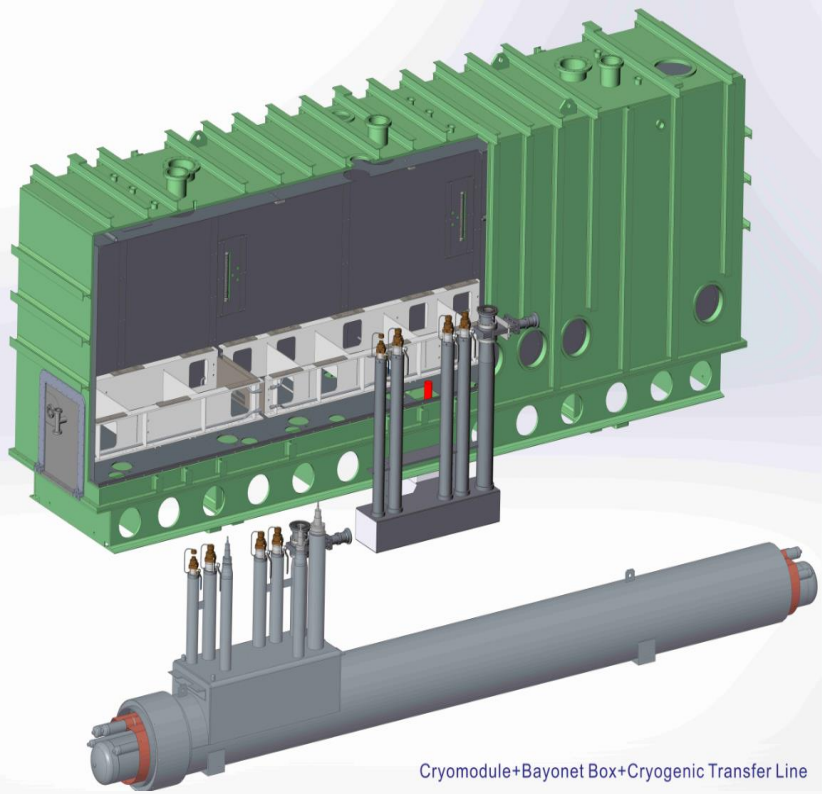
WXCX holds 17 patents in Cryomodule and Vacuum Vessel fabrication in China, and is certified as the provincial engineering center in Jiangsu.

WXCX has various fabrication equipments as well as inspection labs in house.Our national and international customers are satisfied with our products in several researching projects.

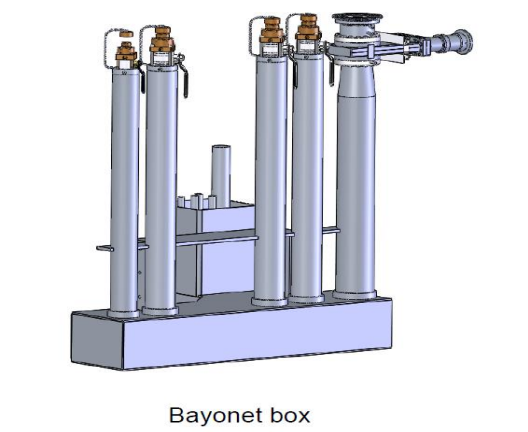
Cryomodules for EXFEL

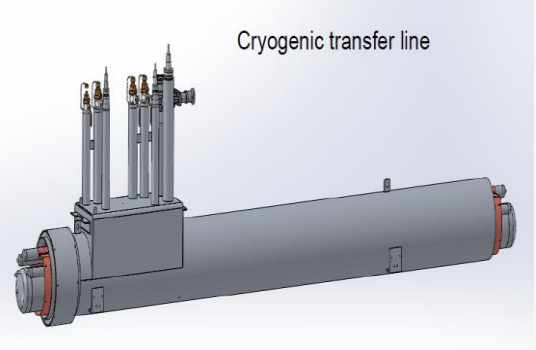
WXCX manufactured the first set Cryomodule cooperated with IHEP in 2010. It passed the technical test in German. And then we got 58 sets Cryomodule order for EXFEL project in 2011. We finished and delivered all cryomodule in 2 years.

Cryomodules for FRIB at MSU



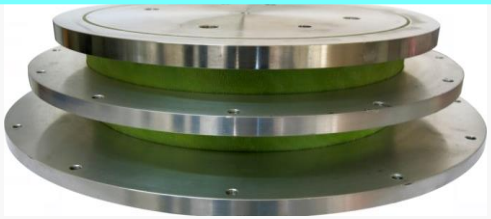
Based on the manufacture experience on cryomodule of EXFEL project, we won the whole order including 49 sets cryomodule, 49 sets bayonet box and 49 sets cryogenic transfer line from MSU in 2016. And we became the excellent supplier of MSU in 2017.





Cryomodules for LCLS II

Also in 2016, we got the cryomodule order from Fermilab through LCLS Ⅱ international bidding because of the manufacture experience on cryomodule of EXFEL project. Until now we have finished and delivered 38 sets 1.3G cryostat and 3sets 3.9G cryostat.



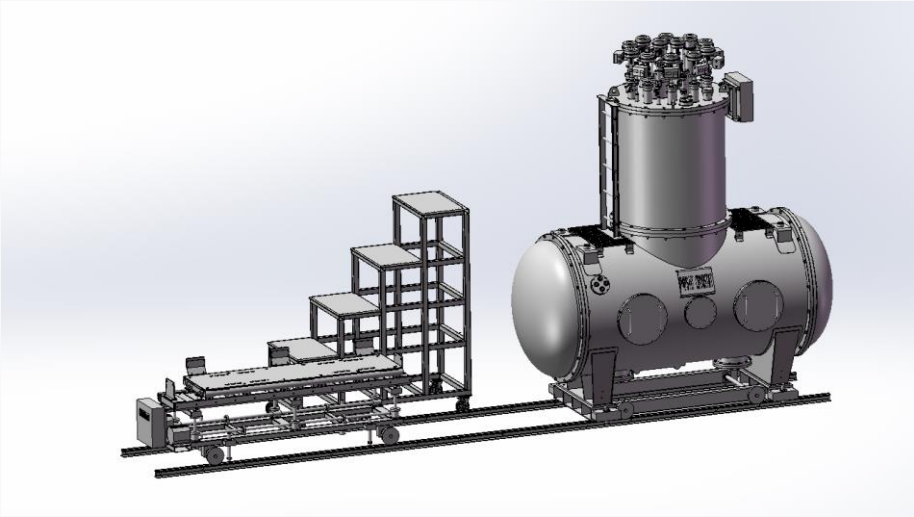
LCLS Ⅱ POST

LCLS Ⅱ Coldmass Upper Assembly

LCLS Ⅱ Vessels

Cryomodules for IHEP ILC Test and CEPC Test

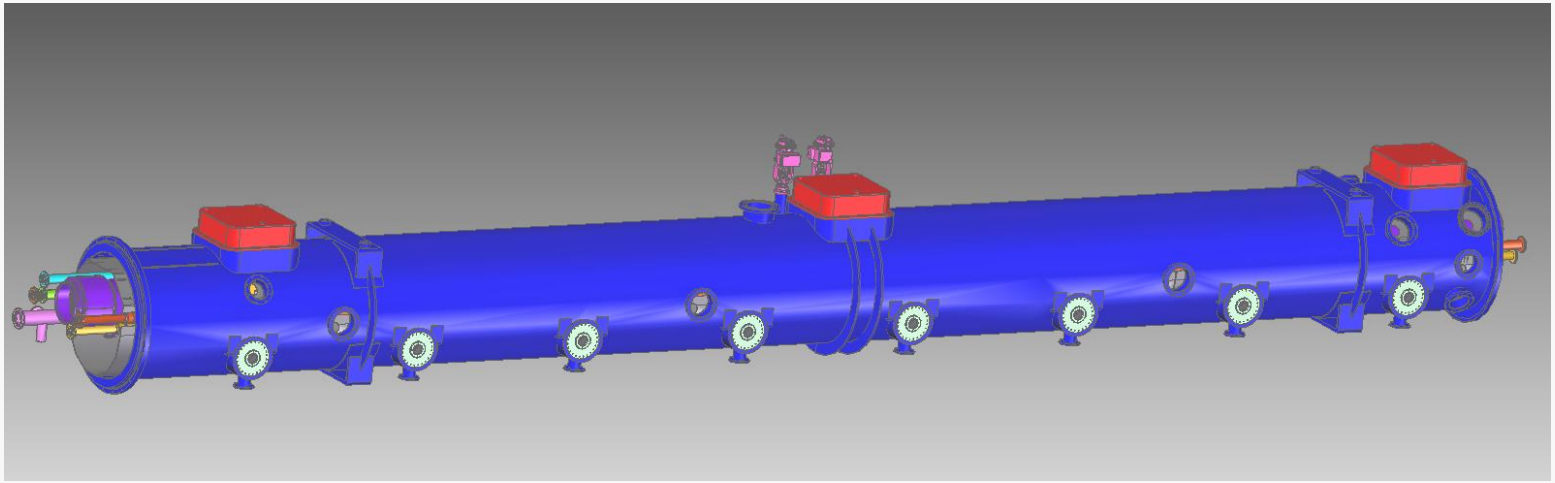
We manufactured one set ILC cryomodule cooperated with IHEP, and it has been sent to the site and put into use .



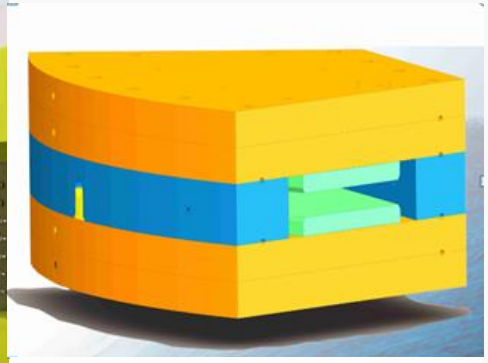
In 2018, we won the CEPC test cryomodule bidding of IHEP, it is in production.

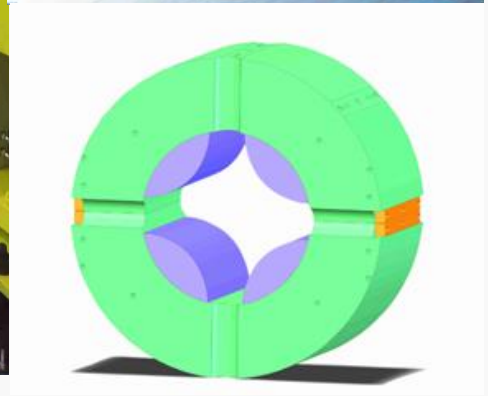
Cryomodule for SHINE (Shanghai XFEL)

In 2018, we research and fabricate one set 1.3G cryostat cooperate with SHINE, SINAP, and estimated delivery time is November of 2018.



Precision structure





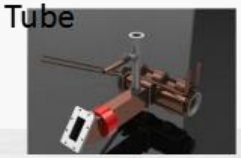
Undulators, bobbin cores, magnet steel and so on

Kunshan GuoLi Electronic Technology Co., Ltd.

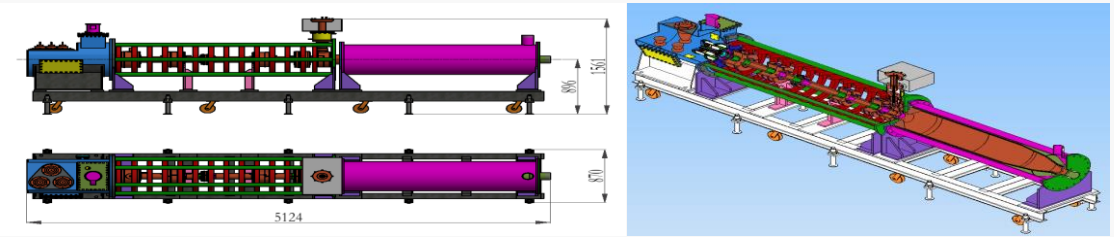
Future 5-Years Development Products

Klystron

Industrial X-Ray Tube



Accelerating Tube



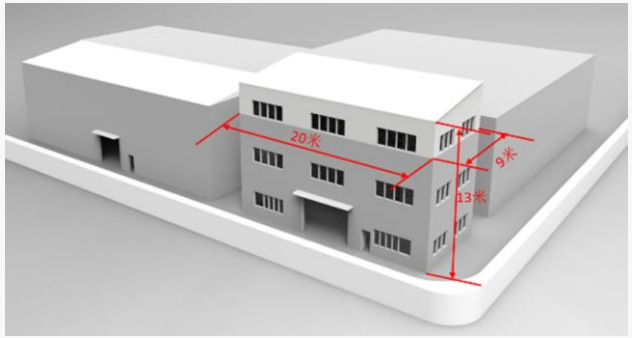
Preliminary mechanical design for UHFKP8001

CEPC 650MHz Klystron

Kunshan GuoLi Electronic Technology Co., Ltd.

1st 650Mhz Klystron Prototype Manufacture Facility

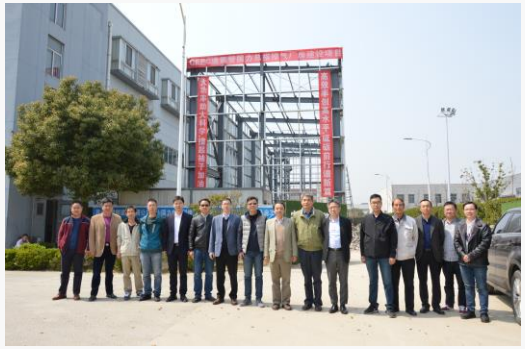
Infrastructure preparation



Plant

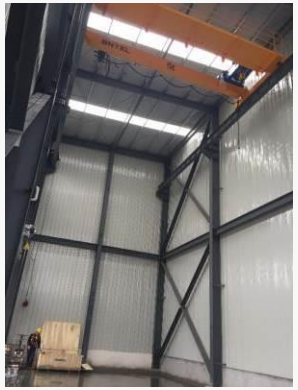
2018.12

2019.1



2019.3

2019.5



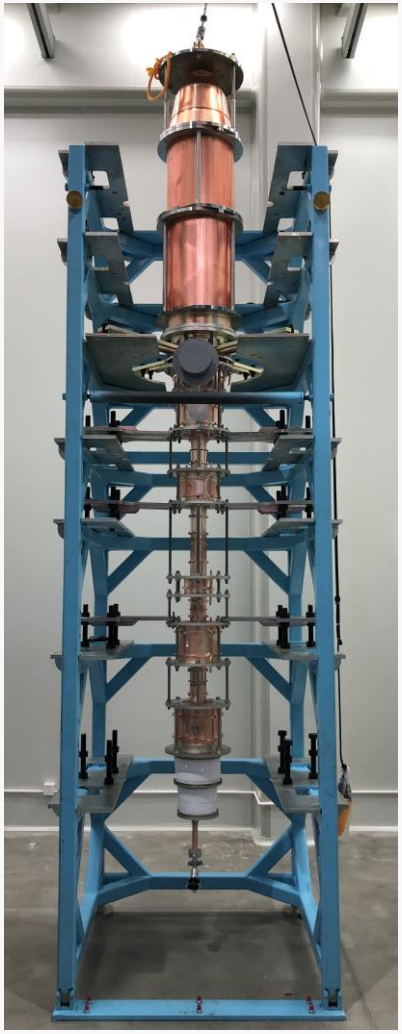
2019.5

46

Kunshan GuoLi Electronic Technology Co., Ltd.

1st 650Mhz Klystron Prototype Manufacture

Baking furnace



The first CEPC 650MHz 800kW Klystron

47

SppC related Domestic Collaboration

"Applied High Temperature Superconductor Collaboration" was established in Oct. 2016.

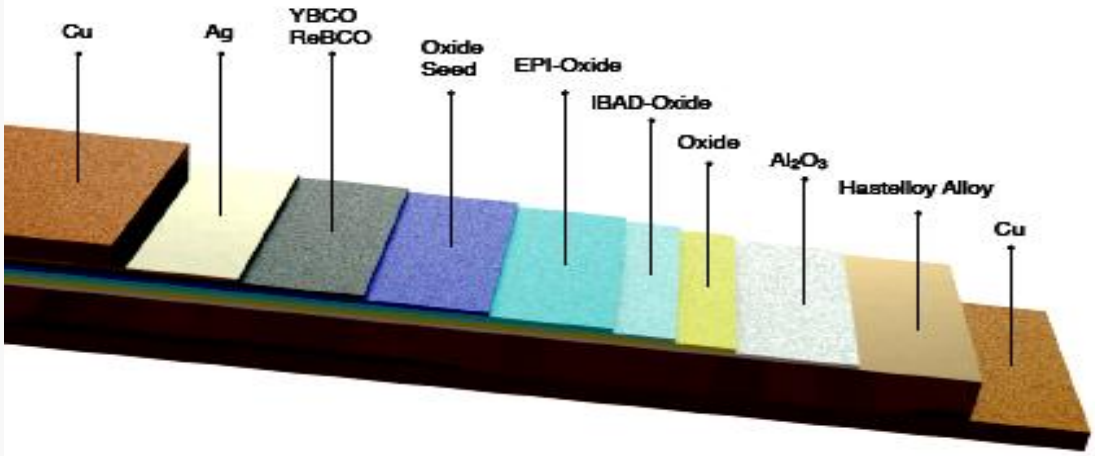
- **Goal**:
  1) To increase the J_c of **IBS** by 10 times, reduce the cost to **20 Rmb/kAm @ 12T & 4.2K**;
  2) To reduce the cost of **ReBCO and Bi-2212** conductors to 20 Rmb/kAm @ 12T & 4.2K;
  3) Realization and Industrialization of iron-based magnet and SRF technology.
- **Working groups**: 1) **Fundamental science** investigation; 2) **IBS** conductor R&D; 3) **ReBCO** conductor R&D; 4) **Bi-2212** conductor R&D; 5) **performance** evaluation; 6) **Magnet and SRF** technology.
- **Collaboration meetings**: every 3 months, to report the progress and discuss plan for next months.

上海上创超导科技有限公司
Shanghai Creative Superconductor Technologies Co., Ltd.
强磁体用第二代高温超导带材
The second generation high-temperature SC tapes

产品简介 Product Introduction

上创超导生产的第二代高温超导带材采用哈氏合金作为基带，YBCO为超导层，使用铜作为加强封装层，可绕包聚酰亚胺作为绝缘层。

SCSC product 2G-HTS wire, Hastelloy Alloy as substrate, YBCO/ReBCO as superconducting layer, Copper/Brass/Stainless Steel as stabilizer, Polyimide Insulating Barrier as option.

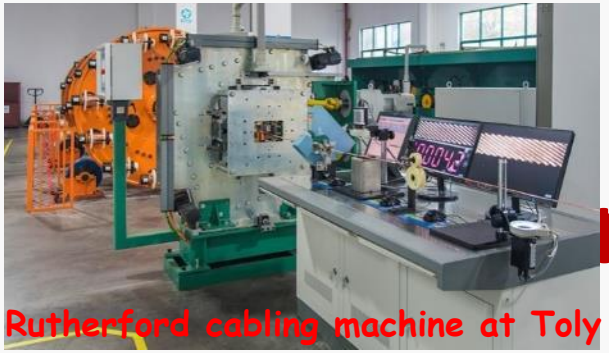


Collaboration between WST, NIN, Toly Electric and IHEP

西部超导

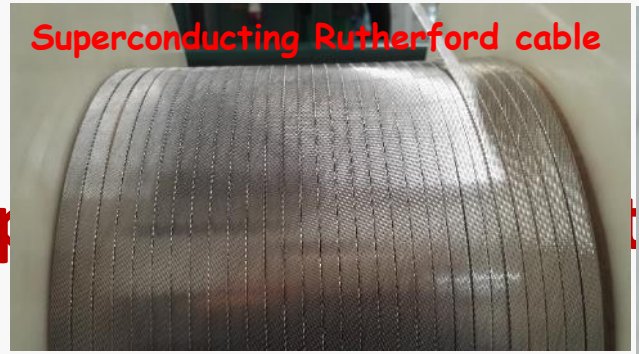
统力电工 TOLY ELECTRIC 永远环绕您的需求 Pursuing your needs forever

NIN



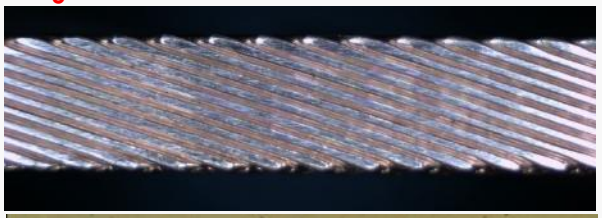
Rutherford cabling machine at Toly

Superconducting Rutherford cable

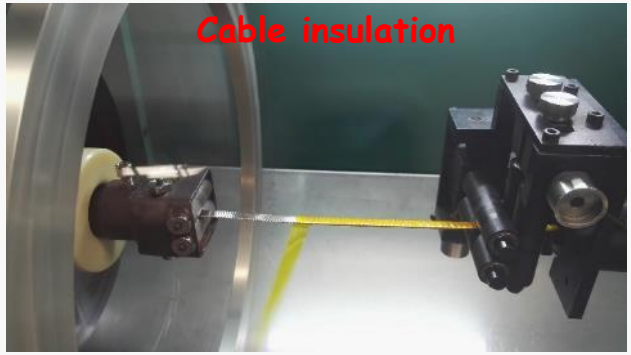


Insulated cable

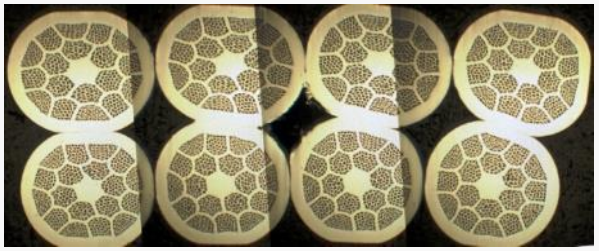
Nb_3Sn Rutherford cable



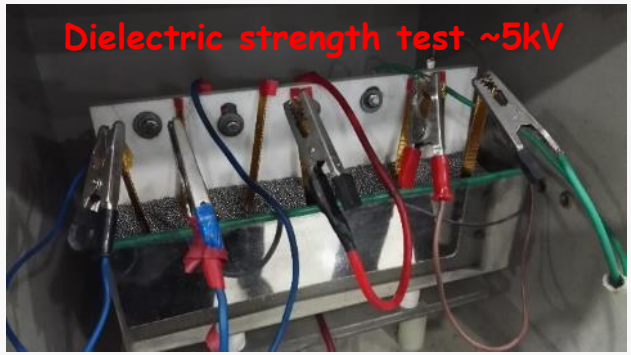
Cable insulation



Bi-2212 Rutherford cable



Dielectric strength test ~5kV



Avic Chendu Aircraft Industrial (Group) Co, Ltd.

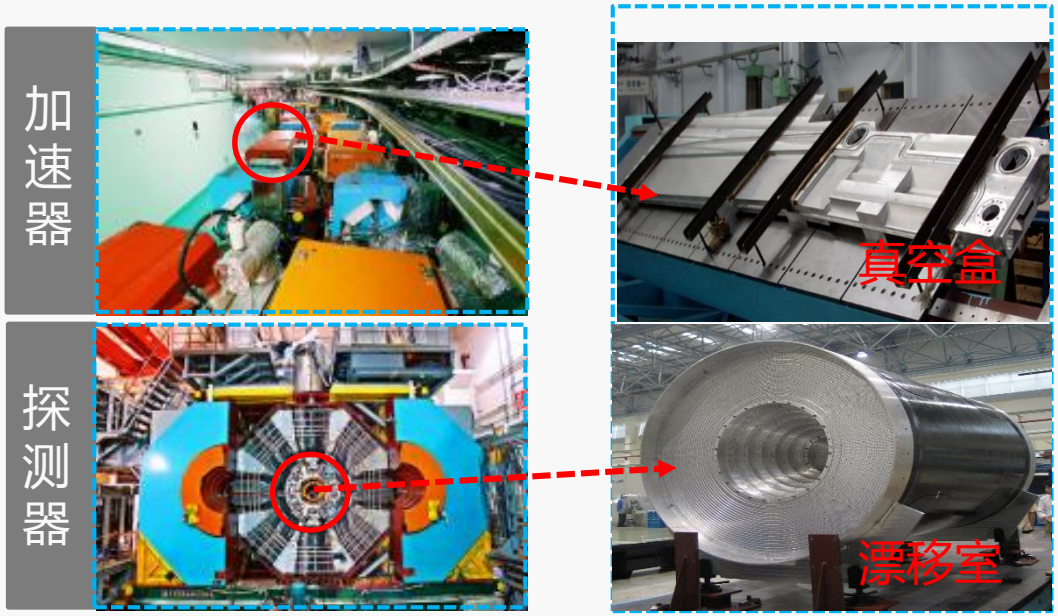
中航工业成都飞机工业（集团）有限责任公司
AVIC CHENG DU AIRCRAFT INDUSTRIAL (GROUP) CO.,LTD.

Chengfei undertook the development the core component of BEPC collider, such as the special vacuum box in the detector and the high performance drift chamber. This work was began in September 2003

The original tunnel of accelerator BEPC is short and round only 240m
(The international success case is more than 2km)

The height of the collision zone of the detector is limited, and the diameter is 5.44 M. In order to achieve the required measurement accuracy, the manufacture and assembly of the detector components are required to be extremely high.

CEPC Detector Precision Machining



Yellow River Conservancy Commission

Project Case—Daya Bay Reactor Neutrino Experimental Station Construction Supporting Project

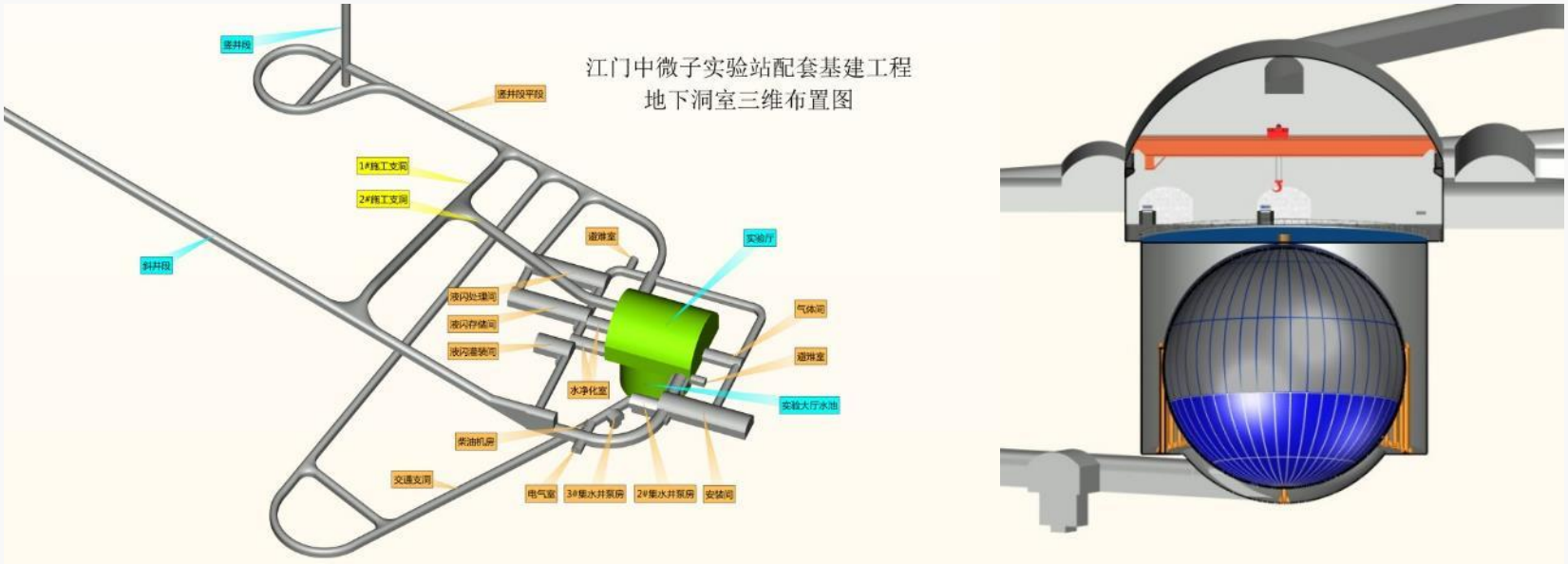
China•Shenzhen•Infrastructure Project

Underground works mainly include five underground laboratory halls, tunnels and a small amount of ground construction and facilities.

The main tunnel section is 2176m x 6.2m x 7.1m (length x width x height), and the size of the largest experiment hall(1#) is 42m x 19.30m x 25.15m (length x width x height).

Yellow River Conservancy Commission

Project Case—JUNO, Jiangmen Neutrino Experimental Station Supporting Infrastructure Project



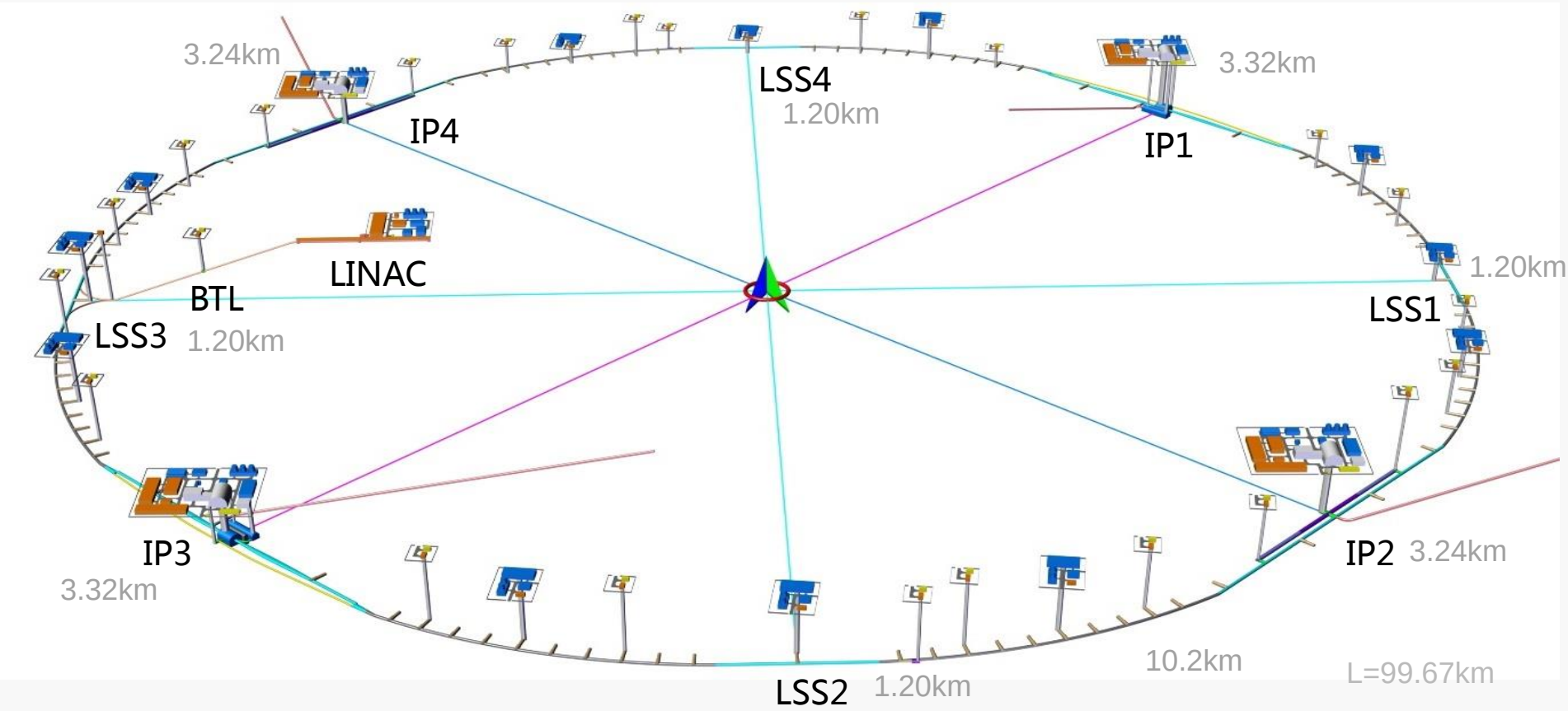
China•Jiangmen•Infrastructure Project

Underground works mainly include shafts, inclined shafts, experimental halls, and auxiliary caverns. The upper excavation section of the experimental hall is 55.65m×48.4m×27.4m (length×width×height). It is the largest underground cavern in China's public data.

Yellow River Conservancy Commission

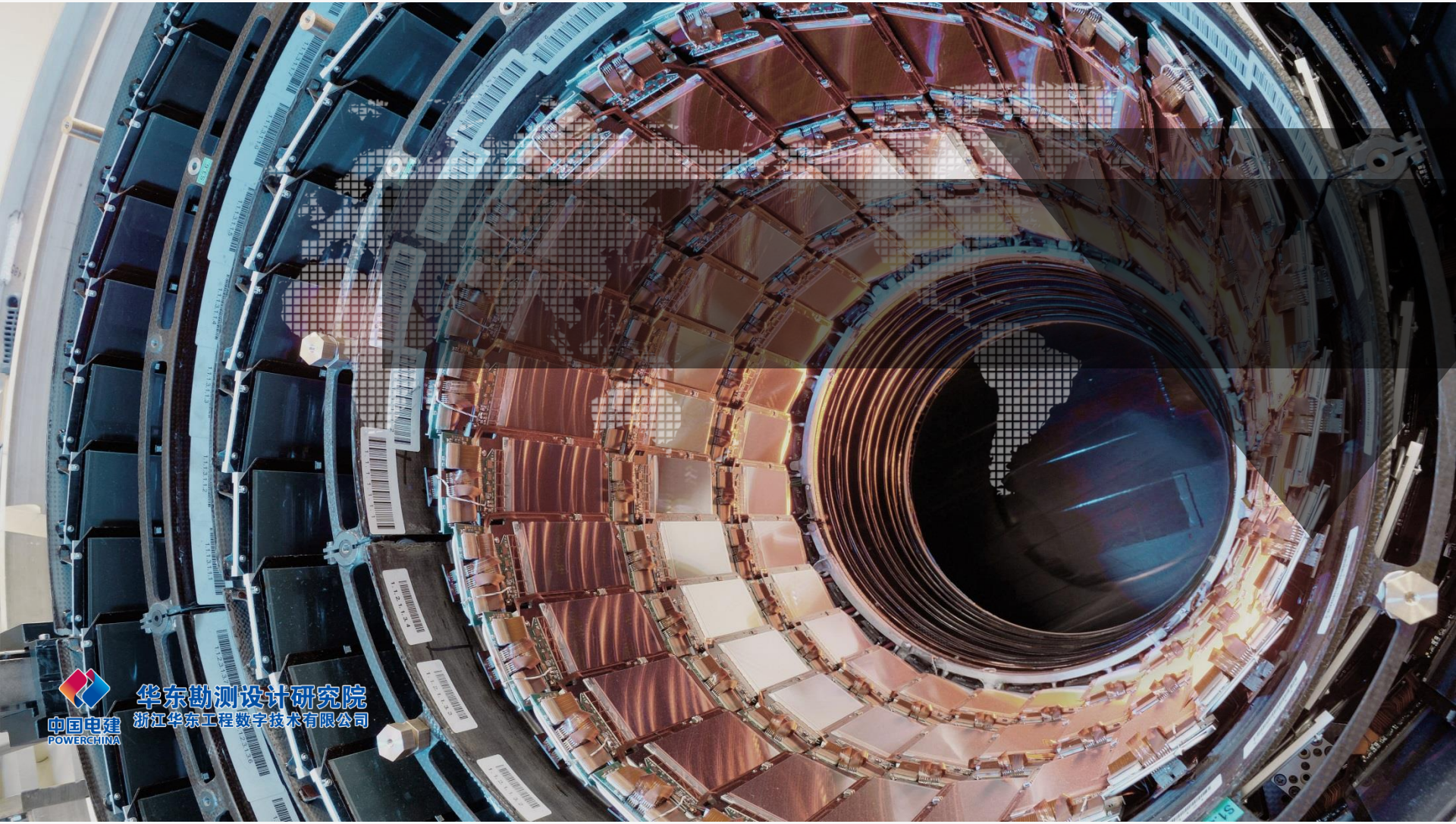
CEPC Civil Enginnering, Siting and Implementation

CEPC General Layout



HUADONG Engineering Corporation Limited

(HDEC)



HUADONG Engineering Corporation Limited

(HDEC)

Jinping II Hydropower Station

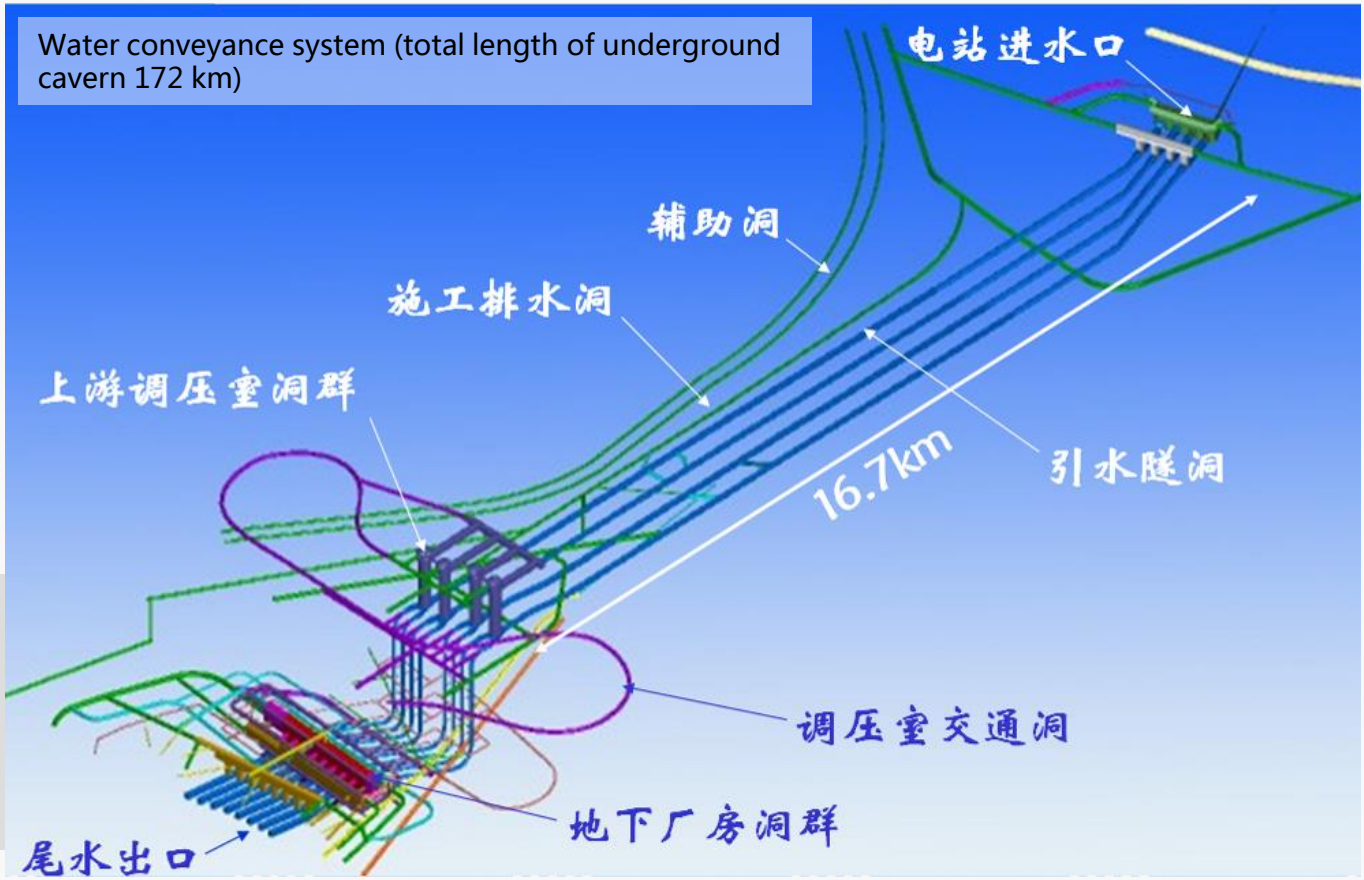
Location：Sichuan Province, China

Installed Capacity：4,800MW(8X600MW)

Completion Year：2012

Project Characteristics：

It is the hydropower station with highest head, largest installed capacity and best efficiency on the Yalong River, and the long diversion-type development is adopted. There are four diversion tunnels with a length of about 17.6km each, maximum overburden thickness of 2525m and max. tunnel diameter of 13m. It is the hydraulic tunnel of the largest comprehensive scale in the world. Thick overburden, high geostress, groundwater and rock outburst involved in design and construction are all of the world-class technical problems.



HUADONG Engineering Corporation Limited

(HDEC)

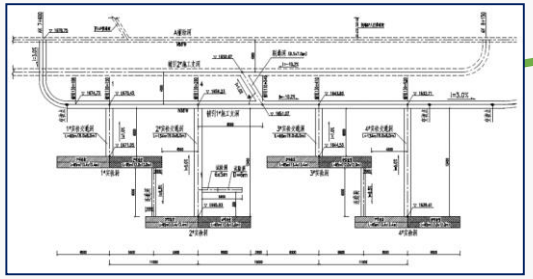
Basic Physics Laboratory-Jinping Dark Matter Experimental Hall

- The first deep underground laboratory in China
- 4,000 m3 (Phase 1)

  120,000 m3 (Phase 2)
- Experiments conducted:

  Rock mechanics,Basic physics,

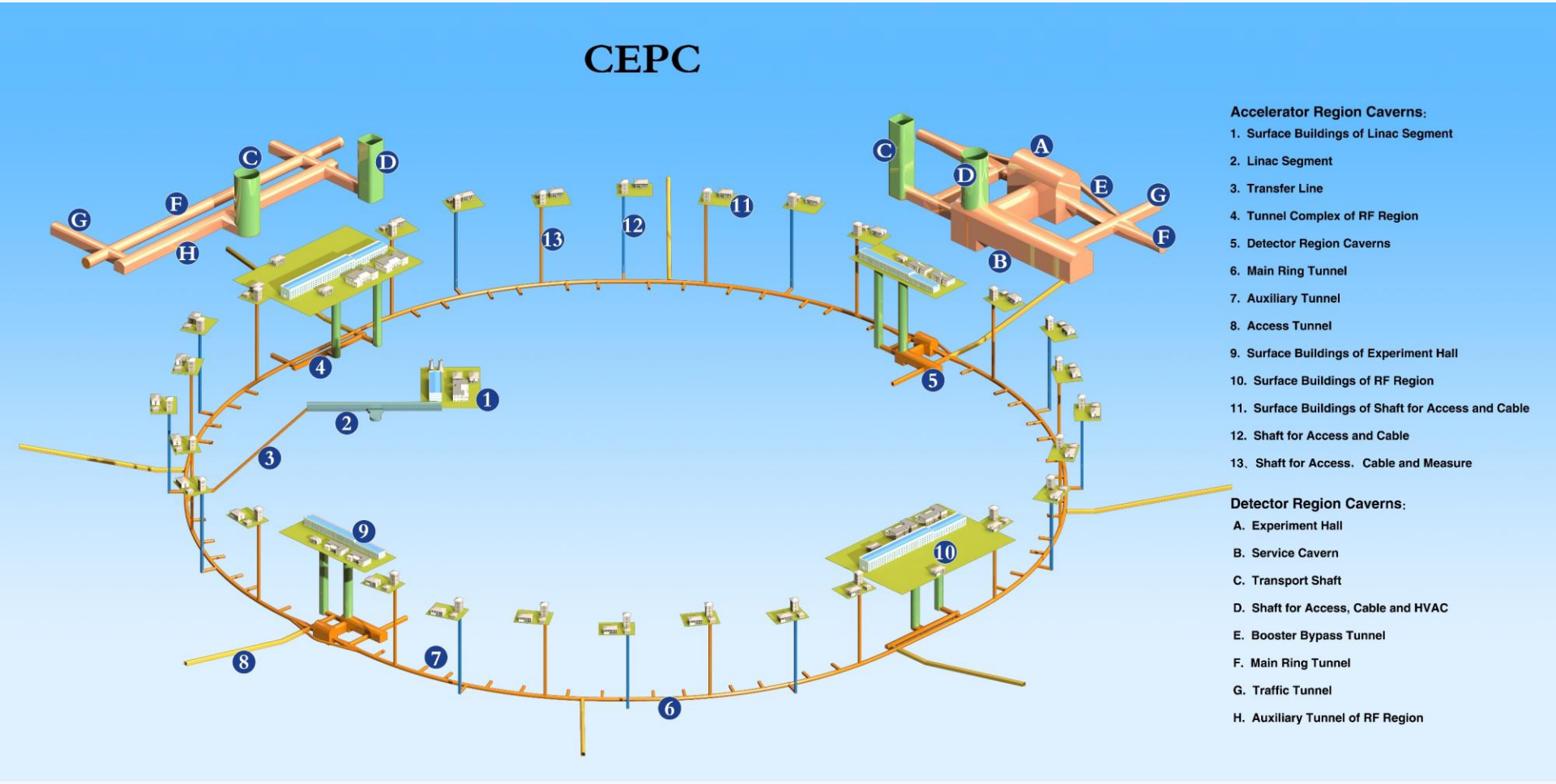
  Seismic research



Underground Basic Physics Laboratory in Jinping II Hydropower Station

HUADONG Engineering Corporation Limited

(HDEC)



Zhongnan Engineering Cooperation Limited

中国电建
POWERCHINA

中国电建集团中南勘测设计研究院有限公司
ZHONGNAN ENGINEERING CORPORATION LIMITED

秉责 创新 卓越

中南院简介

www.msdi.cn

Zhongnan Engineering Cooperation Limited

NEW ENERGYS

GNP Wind Electric Power Thailand

装机容量67.5MW，安装33台Gamesa G114 2.0MW/2.1MW STD2 153m风力发电机机组。以153m高度打破内陆最高柔性风机塔筒应用的世界纪录。

承担工作：EPC总承包

获奖情况：中国勘测设计行业优秀QC小组二等奖
中国电建国际工程优秀项目经理部

Wind Electric Power Hunan, China

装机容量50MW。
承担工作：EPC总承包
获奖情况：中国电建优质工程（产品）奖

Zhongnan Engineering Cooperation Limited

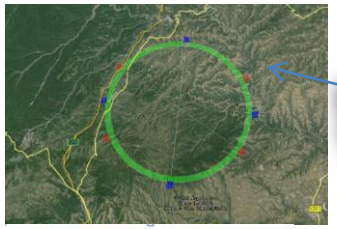
233MW Photovoltaics power station, Algeria

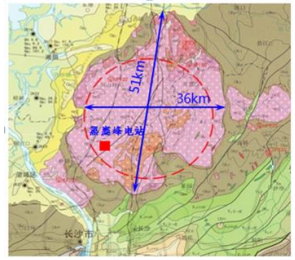
装机容量233MW，撒哈拉沙漠地区，场址多，地质条件各异，是非洲规模最大、单次投资额最大的光伏项目。
承担工作：EPC总承包

50MW Duanhuang Photovoltaics power station, Gansu, China

装机容量50MW，是国内首批20个光热示范项目之一，全球首套熔盐线性菲涅尔光热商业化机组。
承担工作：F+EPC总承包

CEPC Site Selections





6 Huanghe Company particitated

1

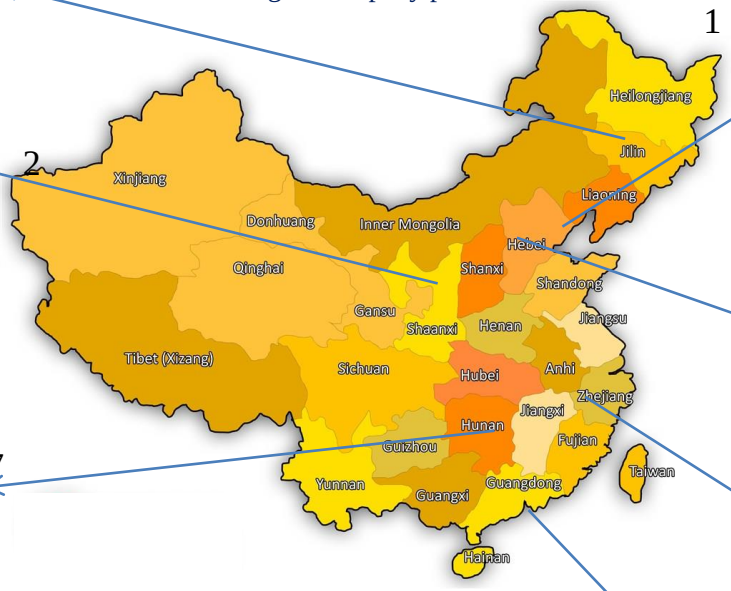
2

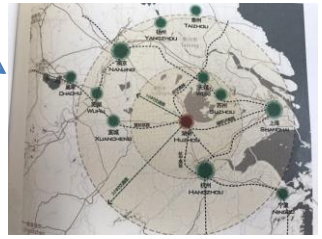
7

3

4

5





1) Qinhuangdao, Hebei Province（Completed in 2014）

2) Huangling, Shanxi Province（Completed in 2017)

3) Shenshan, Guangdong Province(Completed in 2016)

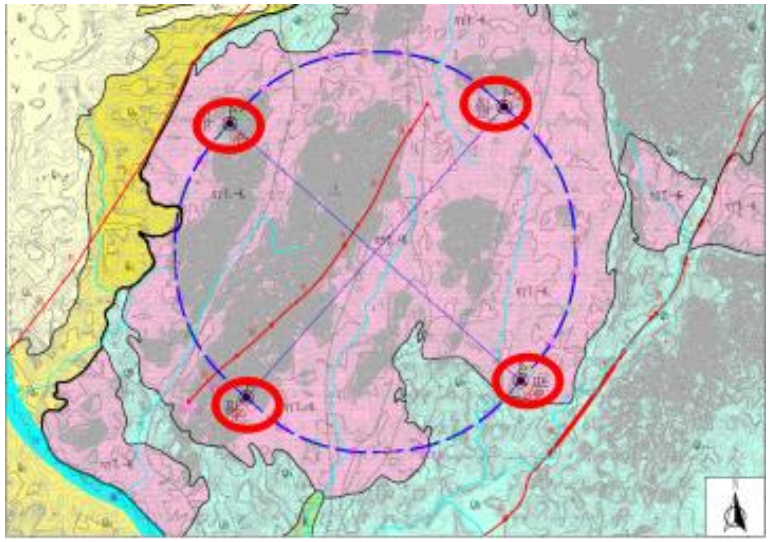
4) Baoding (Xiong an), Hebei Province (Started in August 2017)

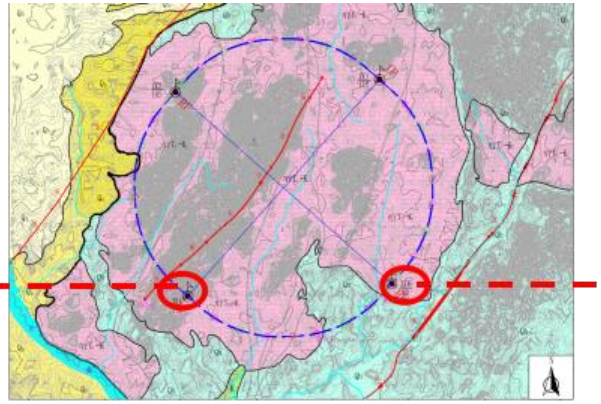
5) Huzhou, Zhejiang Province (Started in March 2018)

6) Chuangchun, Jilin Province (Started in May 2018)

7) Changsha, Hunan Province (Started in Dec. 2018)

CEPC Site Selection in Changsha (Hunan Province)

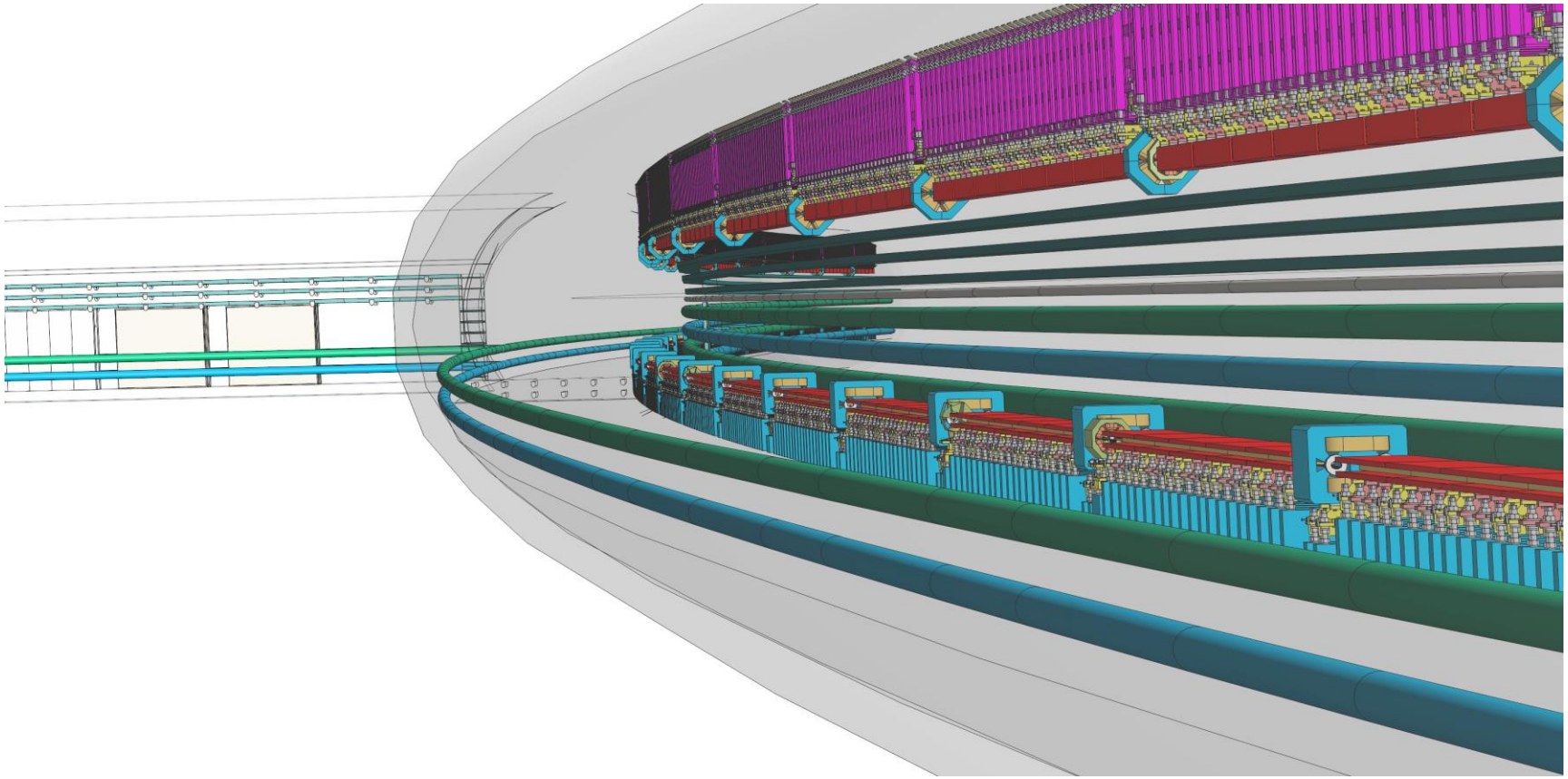




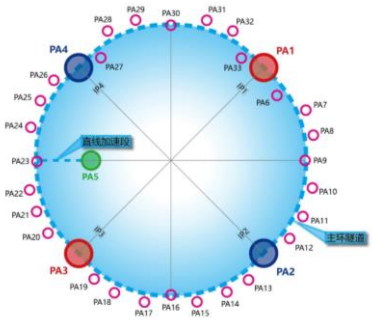
CEPC Tunnel Construction Methods Comparison

Tunnel construction arrangment	Blast and drill	Double shield TBM
Construction tunnel arrangement	Construction tunnel arrangment every 6.25km	Construction tunnel aarangment every 12.5km
Section drill distance	Single direction maxium length 4.325km (1.2km adit +3.125km Main tunnel)	Double shield TBM 53km (5 Machines)
Drill length parameter	Drill 100m/Month Shield 2x85m/Month	Drill/shield : 405m/Month
Construction period	52Months (not including preparation)	40Months (no including preparation)

CEPC Main Tunnel and Auxiliary Tunnel Connection



CEPC Surface Unitity Buidings (Bird view)



Interaction region IP1

SCRF regions 1, 2

Interaction region IP2

Linac injection accelerator

Electric power, cooling and ventilation stations in PA9、PA16、PA23、PA30

Electric power, cooling and ventilation stations in other places

Core Area

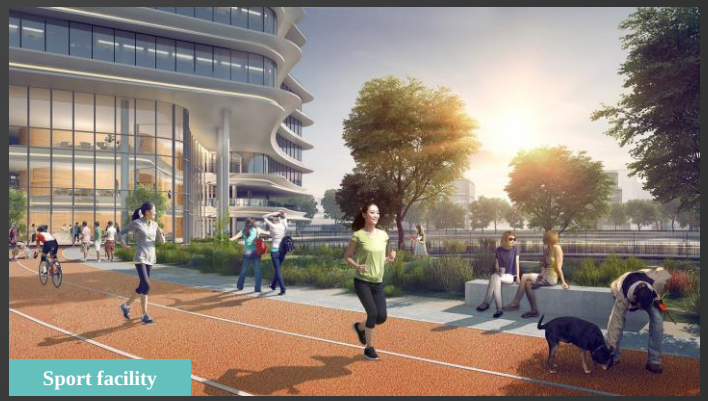
Functional Area


xperimental labs


Experimental hall


Cafeteria


Exibition hall


Sport facility

China Railway Construction Heavy Industry Co., Ltd.

CRCHI

Credibility-Innovation Eternal
Masterpiece-Integrity Coexisting

China Railway Construction Heavy Industry Co., Ltd.

Products•Tunnel boring machine (TBM)

中国铁建重工集团股份有限公司
CHINA RAILWAY CONSTRUCTION HEAVY INDUSTRY CORPORATION LIMITED

- CRCHI is a TBM manufacturer with **the largest production scale, the highest market share and the most complete product range**. CRCHI TBMs take **half** the domestic market in sales, of which large-diameter hard-rock TBM occupies over **85%** of Chinese market share.
- It has produced more than **600 sets** of TBMs which have been widely used in national important projects of metro, railway, mining and water diversion in over **30 cities**, and also exported to Russia, Turkey, India, Sri lanka, Katar, Korea and other countries.

China Railway Construction Heavy Industry Co., Ltd.

Products•Tunnel Boring Machine (TBM)

中国铁建重工集团股份有限公司
CHINA RAILWAY CONSTRUCTION HEAVY INDUSTRY CORPORATION LIMITED

TBM diameter

Series

Mega dia. | Large dia. | Regular dia. | Micro dia. | Mini dia.

Diameter Range

Mini	Micro	Small	Regular	Large	Mega
Case					
• 0.7m pipe jacking machine in Chongqing ; • 0.5m gravity testing machine for Hunan University	• 3.6m & 3.7m EPB in Iran; • 3.7m EPB in Urumchi; • 3.6m teaching-use EPB for Railway Institutes of Shijiazhuang	• 5.5m hard-rock TBM in Lanzhou and Xinjiang; • 5.3m EPB in Turkey; • 4m EPB for Beijing South-to-North Water Transfer Tunnel ; • 4m hard-rock TBM in Zhejiang province ; • 5.6m SPB for PetroChina	• Over 550 TBMs of this kind have been used in national key projects of municipal construction, railway, water diversion tunnel and exported to Russia, Turkey, Korea, Sri Lanca and others.	• Zhengzhou Airport Line 12.7m SPB; • 10.8m SPB for Wangjing Two-way Tunnel; • 11.4m SPB for under-river tunnel in Changde; • 11.7m SPB for Hangzhou metro	• 14.95m SPB for Xiangya Road tunnel in Changsha • 14.95m SPB for Genshan Road tunnel in Hangzhou

China Railway Construction Heavy Industry Co., Ltd.

Products•Tunnel Boring Machine (TBM)

中国铁建重工集团有限公司
CHINA RAILWAY CONSTRUCTION HEAVY INDUSTRY CO.,LTD.

Earth pressure shield machine (ZTE serie)

77 kinds

1. Small diameter
2. Fast tunneling
3. Construction in extremely cold weather
4. Super small turning
5. Gerneral type

……

Slurry pressure shied machine (ZTS serie)

21 kinds

1. Economy
2. Gerneral type
3. Small diameter
4. Big diameter

……

Hard-rock TBM (ZTT serie)

17 kinds

1. Long-distance tunneling & long service time
2. Small type
3. Gerneral type

……

Dual-mode TBM (ZT**serie)

6 kinds

1. Slurry&Earth pressure off-line dual mode
2. Hard rock TBM/Earth pressure dual mode
3. Inclined shaft dual mode
4. Hard rock TBM/Earth pressure online dual mode……

Pipejacking machine (ZTPserie)

5 kinds

1. Super small type
2. Retractable
3.Quick drill -one-time vertical drilling
4. Long distance
5. Muck discharge by a screw

……

Vertical shaft/inclined shaft TBM (ZTJ serie)

2 kinds

1. Vertical shaft TBM
2. Inclined shaft single-shield TBM

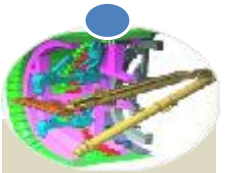
……

Rectangular TBM (ZTR serie)

2 kinds

1.Rectangular pipejacking machine
2. Pipe gallery operating vehicle

Multi-function soft soil TBM (ZT** serie)



1 kind

1. Special-section TBM

8 categories of TBMs Application range covers:

- Soft soil, hard rock and other complicated geologies
- Roung, rectangular and other section shape
- Single mode, dual mode and other tunneling modes
- Straight, curve and inclined shaft and other alignment

China Railway Construction Heavy Industry Co., Ltd.

Products•Specialized Tunneling Equipment

中国铁建重工集团股份有限公司
CHINA RAILWAY CONSTRUCTION HEAVY INDUSTRY CORPORATION LIMITED

- CRCHI is a drilling-blasting equipment manufacturer with **the world's largest production scale, highest market share, most comprehensive product range and highest intelligent level.**
- The company produces **mechanized and smart** construction equipment for drilling and blasting method, providing whole underground construction solutions.
- CRCHI products have been applied in railway construction like **Zhengzhou-Wanzhou High-speed Railway, Anqing-Jiujiang High-speed Railway and Yuxi-Mohan Railway**, and other fields like **national defense, water conservancy, subway, highway and coal mine.**

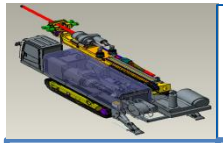
China Railway Construction Heavy Industry Co., Ltd.

Products•Specialized Tunneling Equipment

中国铁建重工集团股份有限公司
CHINA RAILWAY CONSTRUCTION HEAVY INDUSTRY CORPORATION LIMITED

Provide whole underground construction solutions for drilling-blasting method

Advance drilling or advance grouting (5 kinds)


One-kilometer drilling rig

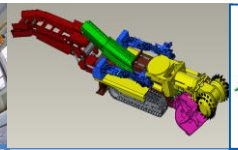

Multi-function drilling rig


Intelligent grouting machine


Horizontal whirl jet drilling rig

Boring & Excavation (26 kinds)


Smart dirlling jumbo


Cantilever type TBM


Drilling and splitting trolley


Pre-tunneling machine

Muck loading and conveying (5 kinds)


Smart shovel loader


Digital digging machine


Crusher

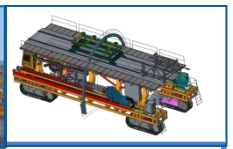

Belt Conveyer

Primary Supporting (31 kinds)


Smart arching jumbo


Intelligent rock bolting jumbo


Smart shotcreting machine


Multi-function vehicle

Secondary Lining (15 kinds)


Digitalized Lining Jumbo


Waterproof board trolley


Maintenance trolley


Invert trestle

Auxiliary Equipment (4 kinds)


High efficiency dust removal trolley


Sewage water processing equipment

Inspection and Maintenance (3 kinds)



Smart lining inspection vehicle

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- Shanghai Creative Superconductor Technologies Co., Ltd.
- Avic Chendu Aircraft Industrial (Group) Co, Ltd.
- Yellow River Conservancy Commission
- HUADONG Engineering Corporation Limited
- Zhongnan Engineering Cooperation Limited
- China Railway Construction Heavy Industry Co., Ltd.

Thank you for your attention