Chinese Industry for CEPC (2020 Summary)

CEPC Industrial promotion Consortium（CIPC）

2020.10.27 Shanghai

Contents

CEPC Extremely High Technical Specs

10 GeV

Electron

1) Injector

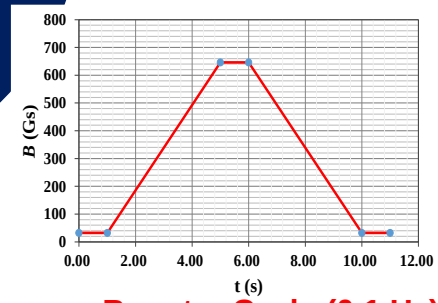
L=1.2km

Positron

2) Booster

C=100km

Energy Ramp
10 ->45/120GeV



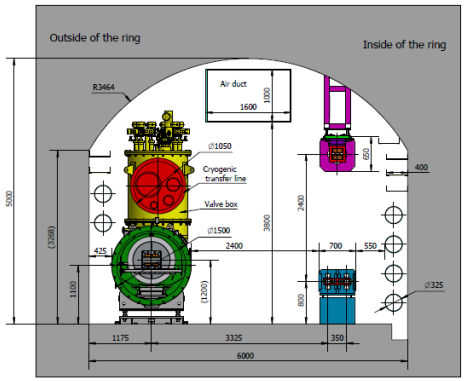
Booster Cycle (0.1 Hz)

Three rings in the sane channel:

- **CEPC & booster**
- **SppC**

5) Civil Eng.

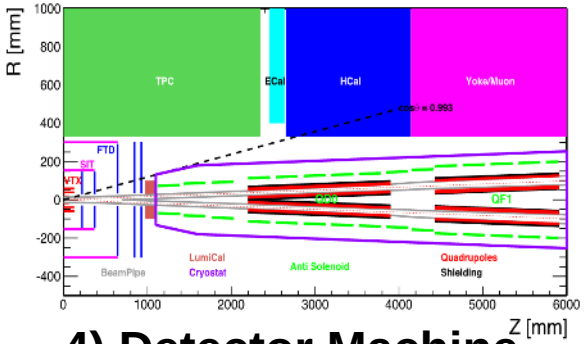
TUNNEL CROSS SECTION OF THE ARC AREA



3) Main Ring

C=100km

45/120 GeV



4) Detector Machine Interface (MDI)

Background

In order to complete well this unprecedented CEPC project;

In order to overcome the CEPC Engineering Complexity;

In order to meet the CEPC Extremely High Technical Specs;

What China Industry should do NOW for CEPC?

Through the CEPC project

How to Stimulate the Development of Manufacturing, Technologies, and Engineering Process of China Industry?

CEPC Industrial Promotion Consortium (CIPC)

As the world's most advanced accelerator,
CEPC put forward the following directions:

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

More than 40 companies joined in first phase of CIPC,
and 70 companies now.

Established in Nov. 7 , 2017

CIPC Organization

CIPC Working group meetings were held on Nov. 24,2017 and Mar. 14 2018. The Executive Committee was established, and the CIPC charter has been drafted and adopted.

CEPC Committee

↓

CEPC Industry Promotion Consortium（CIPC）

↓

CIPC working group

Executive Committee

↓

Member
（>70 Enterprises）

CIPC Logo on the plaque

The representatives of CIPC

序号	姓名	单位	职务	备注
1	高金林 **Gao Jinlin**	北京中科富海低温科技有限公司 Beijing Sinoscience Fullcryo Technology Co., Ltd.	总经理 **GM**	主席 **Chairman**
2	薛华实 **Xue Huashi**	上海上创超导科技有限公司 Shanghai creative superconductor technology Co., Ltd.	总经理 **GM**	副主席 vice chairman
3	李 明 **Li Ming**	中国瑞联集团控股有限公司 China RuiLian Group Ltd.	主席 **Director**	副主席 vice chairman
4	黄 浩 **Huang hao**	昆山国力电子科技股份有限公司 Kunshan national power electronic Technologies Inc.	总经理 **GM**	副主席 vice chairman
5	刘大炜 **Liu Dawei**	成都飞机工业集团有限责任公司 Chengdu aircraft industry Group Ltd.	厂长/高工 **Director**	副主席 vice chairman

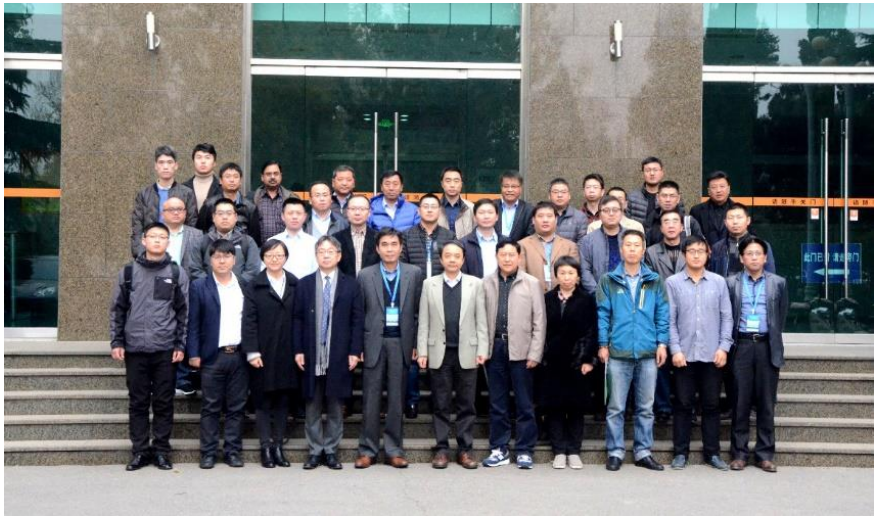
Five representatives of entrepreneurs form the CIPC working group.

Review of CIPC annual meeting

CEPC产业促进会工作组与高能所合影
2017.11.7
Photo of the CIPC working group with IHEP

CEPC产业促进会第一次全体会议
企业代表与高能所合影
Representatives of enterprises in the first plenary meeting
Established in Nov. 7 , 2017

Review of CIPC annual meeting



CEPC产业促进会2018年会
企业代表与高能所合影

Representatives of enterprises in the annual meeting, in July. 26 , 2018

40余家企业，80余人参会

CEPC产业促进会第二次全体会议
企业代表与高能所合影

Representatives of enterprises in the plenary meeting, in Nov. 13 , 2018

30余家企业代表

Review of CIPC annual meeting

- **On July 26, 2018,** led by the IHEP,CAS, nearly 100 guests from more than 40 member enterprises of CIPC gathered at Beijing to hold a grand "**Sharing Opportunities, and Win-Win Cooperation 2018 CIPC Annual Meeting**" to **discuss the future development strategy of Chinese industry about CEPC. The annual meeting elects the CIPC Bureau and executive committee**.
- **On Oct. 22-26, 2018,** CIPC presetnted a **report-China Industry for CEPC** at LCWS2018 in Arlington, Texas,USA.
- **On Nov. 12-14, 2018**, attended the CEPC International Conference, and held the CIPC parallel sessions and plenary meeting. On November 14th, the (CEPC) research group officially released the CEPC Conceptual Design Report (CDR), which are the "Conceptual Design Report -- accelerator Volume" and "Conceptual Design Report -- Detector and Physics Volume". The workshop also intends to develop initial plans towards Technical Design Reports (TDR).

Review of CIPC annual meeting

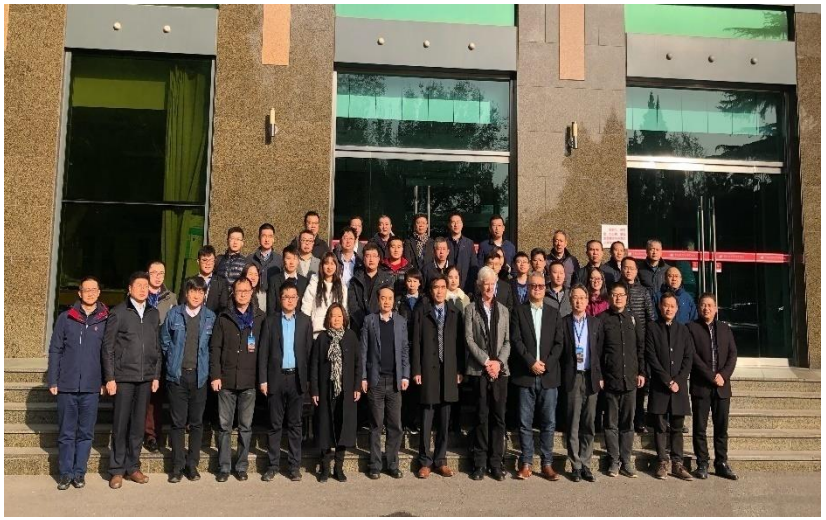
Cryogenics workshop on TDR of CEPC
Nov 27, 2018, IHEP, Beijing, China

- Nearly 20 participants from the backbones of Fullcryo, Hefei Juneng new energy, Jiangsu Cryote, CSIC Pengli, Anhui Wacree, Wuxi innovation and other companies, with the scientific researchers from the IHEP and the Institute of physics and chemistry, CAS.

CIPC working group meeting On June 4,2019

- On June 4, CIPC held the working meeting of the presidium in 2019. Five member participated in the meeting, with Dr. Gao Jie, vice chairman of CEPC organization committee.

Review of CIPC annual meeting



CEPC产业促进会-基金会
企业代表与高能所合影
Representatives of CIPC Foundations in the plenary meeting, in Nov. 21 , 2019

CEPC产业促进会第三次全体会议
企业代表与高能所合影
Representatives of enterprises in the plenary meeting, in Nov. 19 , 2019
64位代表，52个报告

CIPC members

LEIKE 雷科电子

KAITENG SIFANG

汉光科技

北广科技 BBEF

上创超导

Superconductor Technology 苏州八匹马超导科技有限公司

上海辰光医疗科技股份有限公司 Shanghai Chenguang Medical Technologies Co. Ltd

上海普東科技 PUSU

VACREE

昆山国力电子科技股份有限公司 Kunshan GuoLi Electronic Technology Co., Ltd.

中科富海 FULLCRYO

Western Superconducting Technologies Co.,Ltd.

江苏克劳特低温 JiangSu Cryote Co., Ltd.

JJJvac 三井真空

普达迪泰 PRODETEC

北京航天广通科技有限公司 Beijing Grantel Technology Co., Ltd.

北京鼎荣达

VACUUM PRODUCTS

中船重工鹏力（南京）超低温技术有限公司 CSIC PRIDe (NANJING) CRYOGENIC TECHNOLOGY CO.,LTD.

SKY

中国电建 POWERCHINA 中国电建集团昆明勘测设计研究院有限公司 KUNMING ENGINEERING CORPORATION LIMITED

HUALUN

EDWARDS

统力电工 TOLY ELECTRIC

慧宇 HUI YU

中铁装备 CREG

SEALTECH

CIPC members

高能锐新 HE-RACING TECHNOLOGY

上海超导 SHANGHAI SUPERCONDUCTOR

爱科赛博 ACTIONPOWER

正机科技 GENTECH

地矿建设 DIKUANG CONSTRUCTION

中国电建 POWERCHINA

海南展创光电技术有限公司 HZC PHOTONICS

天合精机 TIAN HE JING JI

黄河勘测规划设计研究院有限公司 Yellow River Engineering Consulting Co., Ltd.

中国铁建

HDKY浩德科仪 HoldKY Vacuum Technologies

中国电建 POWERCHINA 华东勘测设计研究院 HUADONG ENGINEERING CORPORATION

RuiYuan

瑞隆 Rui Long

NVT

冰轮环境 MOON-TECH

BRARC

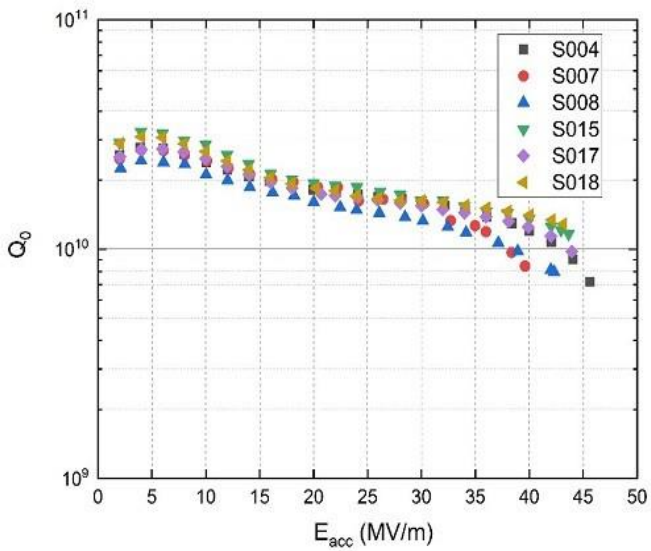
CBWAC

东方晨景 East Changing

JST 金盘科技 JINPAN TECHNOLOGY

东方钽业 OTIC 中国有色集团成员企业

Important progress in high performance 1.3 GHz superconducting cavity



1.3 GHz 单cell超导腔垂直测试结果

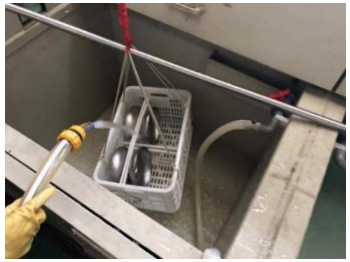
Vertical test results of 1.3 GHz single cell superconducting cavity

- In December 2019, six fine-grained pure niobium 1.3GHz single cell superconducting cavities were developed by the radio frequency superconductivity and cryogenic research center of IHEP (including Beijing high energy Ruixin Technology Co., Ltd.).
- The acceleration gradient of 2K vertical test reached or exceeded 40mv / m. Among them, the highest acceleration gradient of S004 cavity is 45.6mv/m, which is close to the theoretical limit of Tesla pure niobium cavity; and the quality factor Q_0 of S018 cavity at 43mv / M gradient reaches the international leading level of 1.3×10^{10}.
- This progress marks that the R & D, manufacturing and post-processing technology and supporting facilities have laid an important foundation for the next development of high gradient and high-quality factor 1.3GHz 9-cell superconducting cavity and others.

• 1.3GHz 9-Cell Cavity

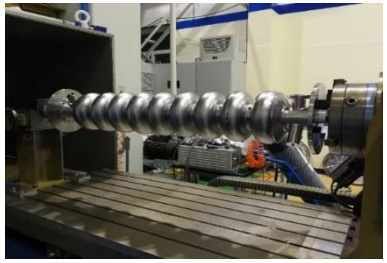












12 cavities have been manufactured for High Gradient and High Q R&D work.

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

北京高能锐新科技有限责任公司
Beijing HE-Racing Technology Co., Ltd.

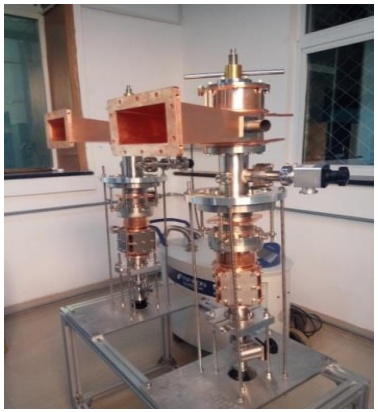
SRF Cavities and FPCs R&D for CEPC

ADS RFQ耦合器

CSNS聚束腔耦合器

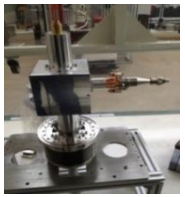
CSNS RFQ耦合器

FPCs for RF Cavities



1.3GHz 9 Cell
双窗可调耦合器

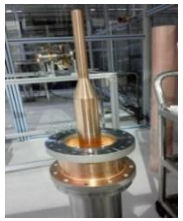
1.3GHz 9 Cell腔耦合器



162.5MHz HWR腔耦合器

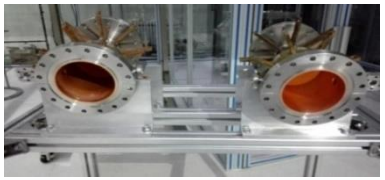
500MHz 超导腔耦合器

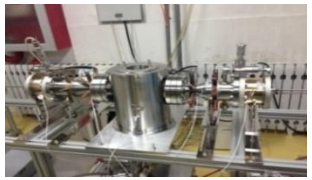
166.6MHz QWR腔耦合器(HEPS-TF)



325MHz Spoke 腔耦合器

325MHz Spoke 腔耦合器



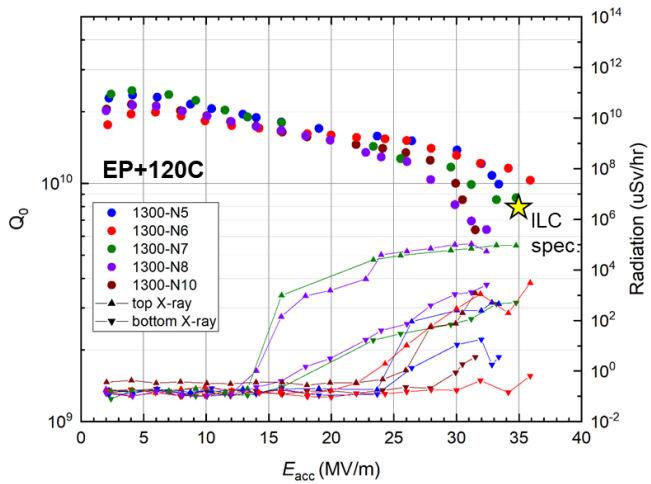


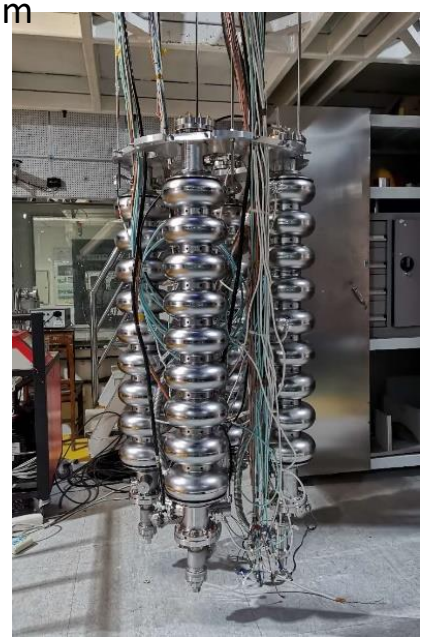
PFCs for SRF Cavities

PFCs for Cavitiy

High Gradient 1.3GHz 9-cell Cavity (EP)

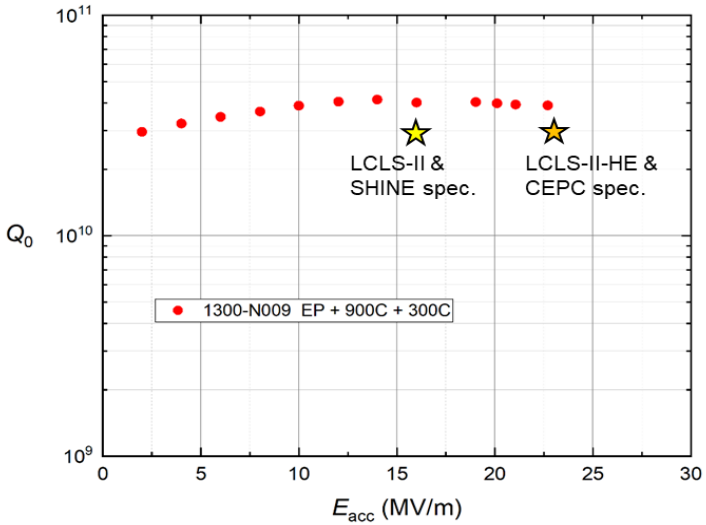
- High gradient is the basis for high Q because of large gradient degradation
- With new EP tool, only 5 months to achieve 36 MV/m on 9-cell cavity
- All of the five 9-cell cavities > 30 MV/m, cell gradient near or above 40 MV/m
- Two main FE sources: EP sulfur contamination, HPR contamination
- Further push the gradient to 35~40 MV/m with 90% yield



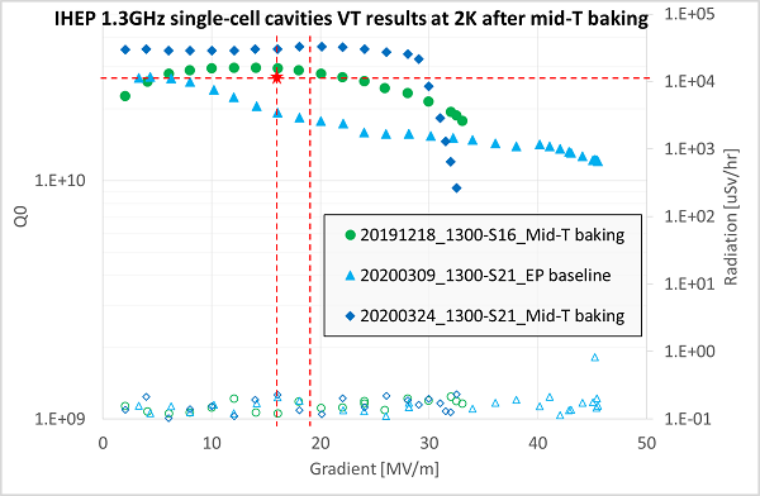


High Q 1.3GHz 9-cell Cavity (Mid-T Annealing)

- World's first mid-T high Q 9-cell cavity. 4E10@16 MV/m. 3.9E10@22.7 MV/m quench.
- Exceed LCLS-II and SHINE spec. Close to LCLS-II-HE (2.7E10@23 MV/m) and CEPC (3E10@24 MV/m) spec.
- Further push the gradient and yield by light cold EP between 900 C and 300 C.



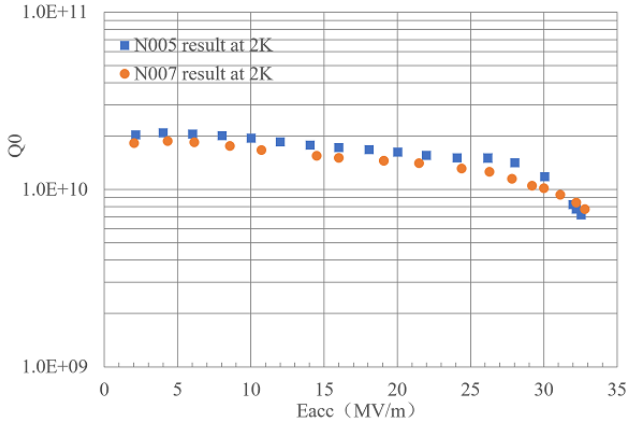
Lead in developing new technology of superconducting cavity



1.3 GHz 单cell超导腔垂直测试结果

- On March 24, aiming at the ultimate goal of high Q and high gradient superconducting cavity research in the world, new progress has been made in the research and development of medium temperature baking and annealing process for superconducting cavity. The Q value is greatly increased by using this process on the premise of maintaining high gradient of superconducting cavity.
- The acceleration gradient of 1.3 GHz single cell (PAPS-HTF-1300-S016) with medium temperature baking process reaches 33MV/m under 2K vertical test, and the Q_0 is about 1.8×10^{10}. Another superconducting cavity (No. PAPS-HNF-1300-S021) has a Q_0 greater than 3.5×10^{10} when the acceleration gradient is 25mV / m at 2K.

Continuous development of 1.3GHz 9-cell superconducting cavity



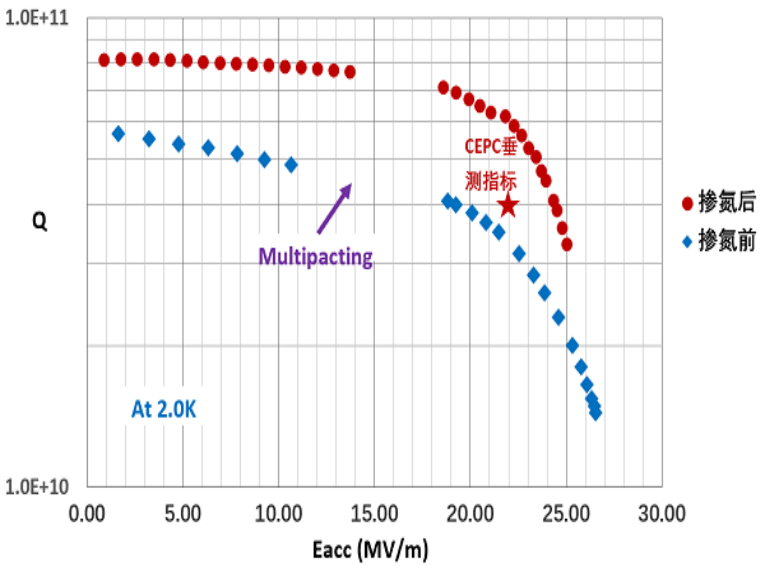
1.3 GHz 9-cell超导腔垂直测试结果

1.3 GHz 9-cell超导腔低温垂测

Cryogenic vertical test of 1.3 GHz 9-cell superconducting cavity

- On July 24 and 30, two 1.3GHz 9-cell superconducting cavities with end cavity assembly in IHEP, were tested at 2K temperature. The acceleration gradient was 32.8MV/m and 32.6MV/m respectively, and the quality factor Q_0 was more than 1×10^{10} at 30MV/m. This test result is the best result of the fine grain 1.3 GHz 9-cell superconducting cavity developed in China.
- It has achieved a great leap forward in the index of domestic fine grain superconducting cavity, and is in line with the level of 35 ± 20% MV/m (28 MV/m to 42 MV/m) @ 8×10^9 of the International Linear Collider (ILC).
- Fine grained 1.3GHz 9-cell superconducting cavity is widely used in the world's major accelerator projects, such as Euro-XFEL、USA-LCLS-II. It will also be used in future accelerators such as SHINE, CEPC and ILC.

CEPC 650 MHz 2-cell superconducting cavity vertical test up to standard



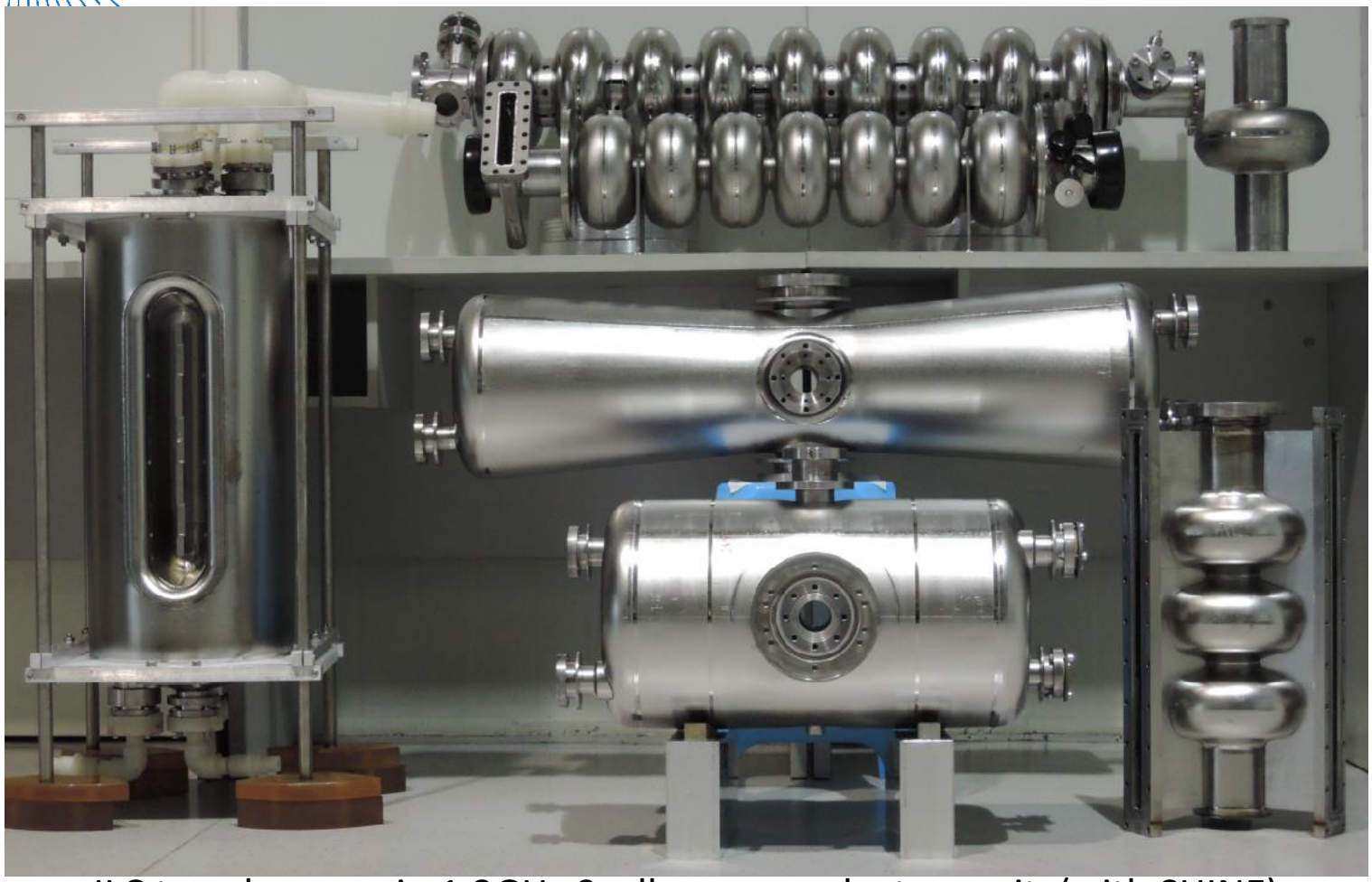
CEPC 650 MHz 2-cell超导腔垂直测试结果

- On June 12, CEPC 650 MHz test results show that Q value exceeds 6E10 (corresponding to the microwave surface resistance is only 4.7n Ω) when the acceleration gradient EACC reaches 22MV/m at 2K, which exceeds the vertical measurement index of CEPC （ Q=4E10@Eacc=22MV/m ）.It has reached a record high and is comparable to the international leading level.
- In the process of testing, 650 MHz 2-cell superconducting cavity was firstly treated by buffer chemical polishing (BCP), and then the vertical measurement before nitrogen doping was completed; then completed the vertical measurement after nitrogen doping, the Q value was greatly improved, the Q value reached 8E10 at low field (10MV/m), and the quench was at 25MV/m.

Ningxia Orient Tantalum Industrial Co.,Ltd.

1.3G 3-cell slot cavity for National Natural Science Foundation Project(with IHEP)

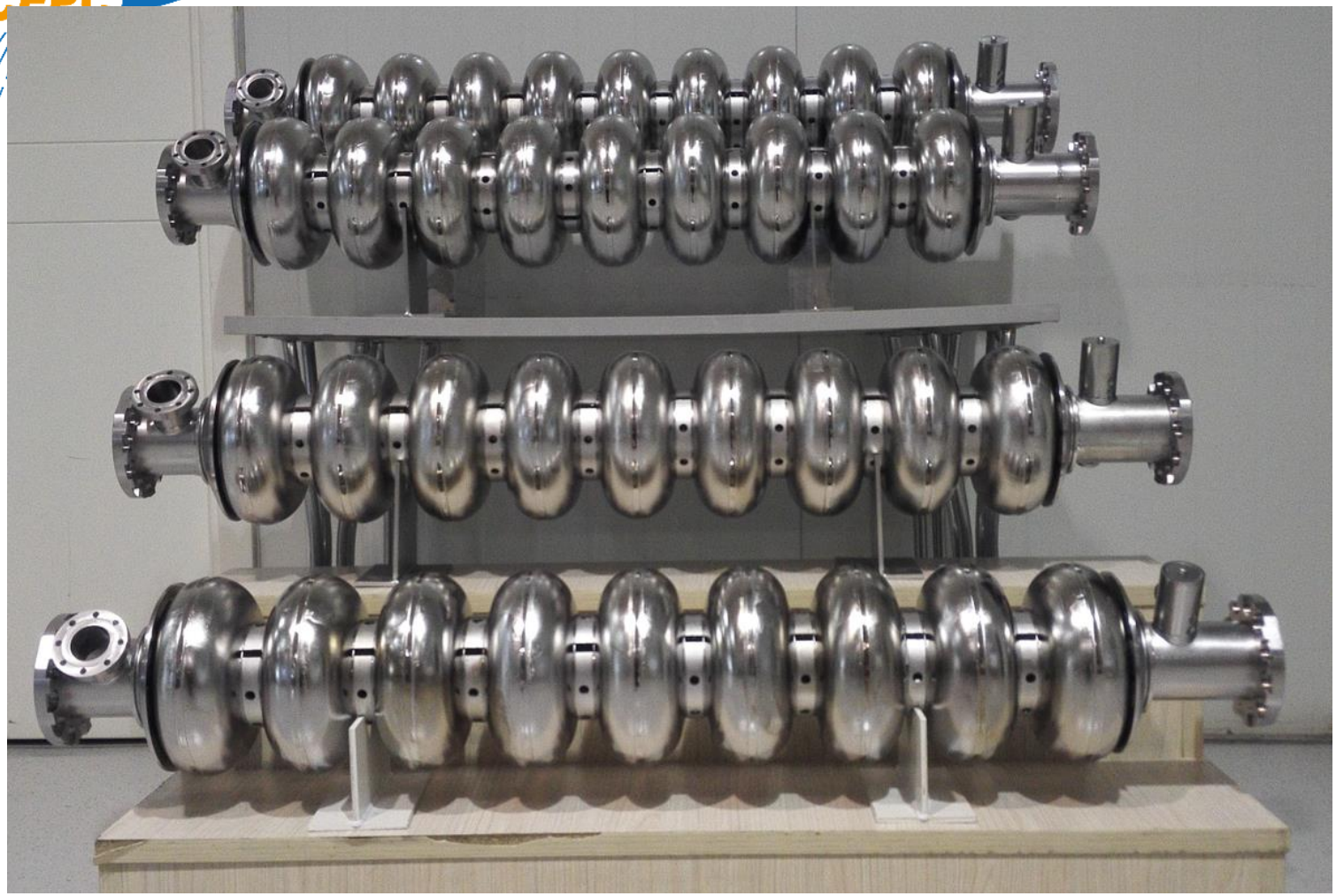
Ningxia Orient Tantalum Industrial Co.,Ltd.



ILC type large grain 1.3GHz 9cell superconductor cavity(with SHINE)

162.5MHz Taper type HWR 009 superconductor cavity(with PKU)

Ningxia Orient Tantalum Industrial Co.,Ltd.



1.3GHz 9cell large grain superconductor cavities

Progress in Niobium material

650MHz LG Cavity for CEPC

The first sample of CEPC 650MHz klystron completed the test of pulse power 800KW and CW power 400KW

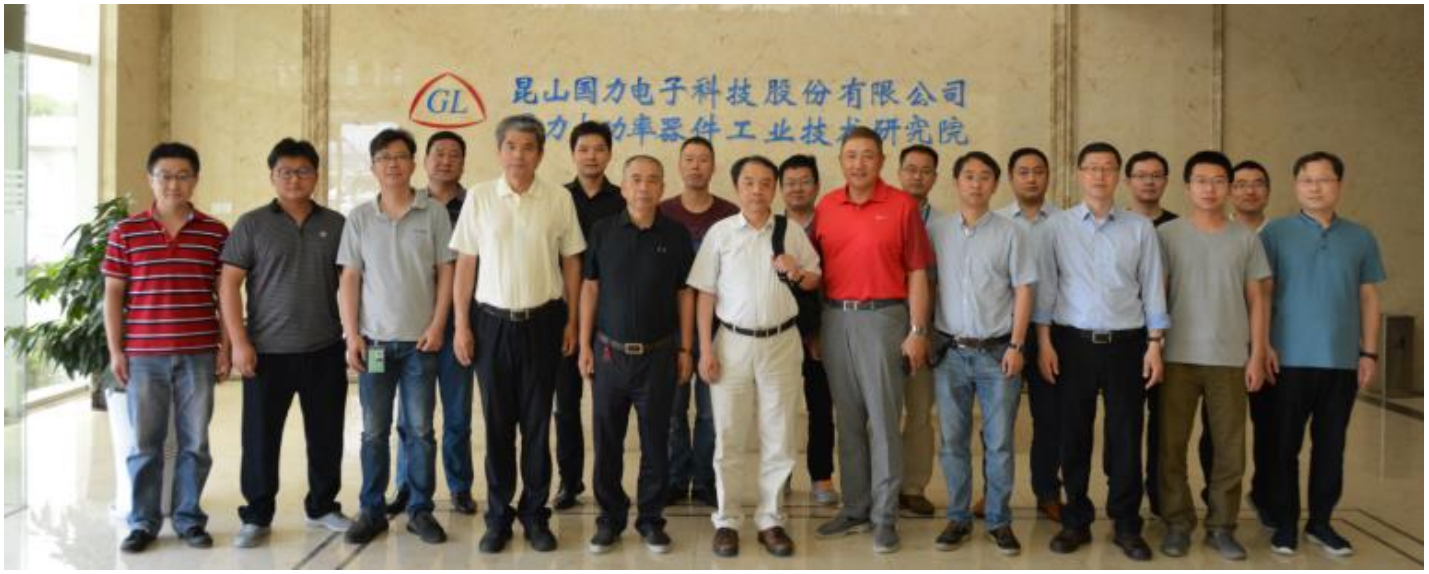
CEPC 650MHz速调管样管

CEPC 650MHz速调管样管就位排气台

- On February 27 and March 7, 2020, the output power of the 650MHz klystron of CEPC reaches 400KW CW and 800KW pulse (duty cycle 40%) respectively.
- At 800KW power, the microwave conversion efficiency is 62%, 1dB bandwidth is more than 1.0 MHz, and gain is more than 43db. That is the first 650MHz CW klystron in the world.
- CEPC 650MHz klystron sample tube is developed. The design is completed by the IHEP. The **Institute of Electronics** undertakes the processing of electron gun and resonant cavity series. **Kunshan Guoli high power device Industrial Technology Research Institute Co., Ltd.** undertakes the integration and related ancillary equipment processing. With the support of **Kunshan government**, the required assembly plant and exhaust station are built.
- The successful development has accumulated valuable experience and laid a solid foundation for the ongoing development of high-efficiency continuous wave klystron. It is also an important breakthrough in the key TDR (technical design report) stage.

IT IS A JOINT PROJECT

To develop the 650MHz/800kW CW klystron for CEPC and push its efficiency up to 80%, IHEP, IECAS and GLVAC established the collaboration group for the klystron development in 12th 2017, and its group meeting was held every 3 months.

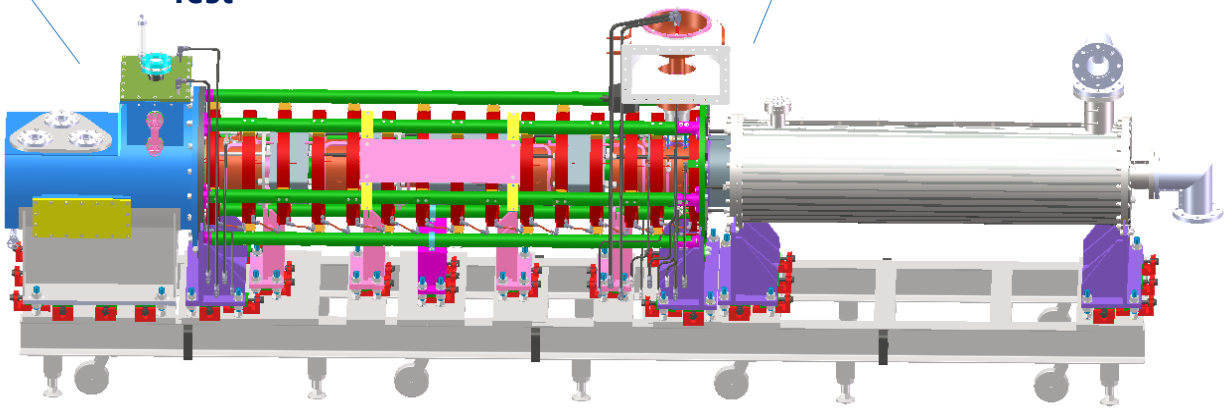


Collaboration group meeting held in GLVAC (6th 2018)

Work of first CEPC klystron in GLVAC

- Design
- Final assembly (participate)
- Baking (participate)
- Following process (participate)
- Test

- E-gun
- Cavities
- Final assembly (participate)
- Baking (participate)

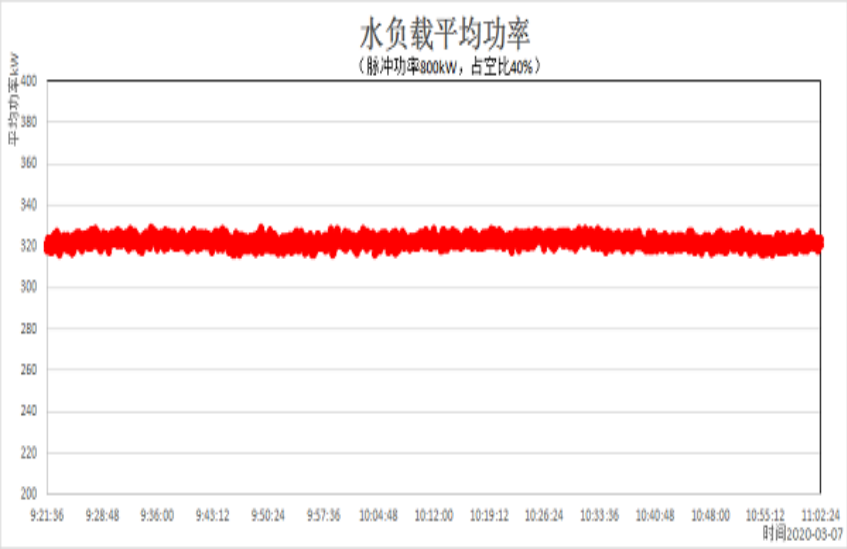


- Collector
- Coils
- Oil cylinder
- Operation support

- Final assembly & baking
- Following process
- Klystron pack & transport
- Test (participate)

Test result

- The klystron has been tested in IHEP
  - Output power: 400kW CW or 800kW 40% duty ratio (limited by the test platform)
  - Efficiency: 62% (63% design value)
  - Gain: 43dB
  - Bandwidth: >1MHz (1dB)

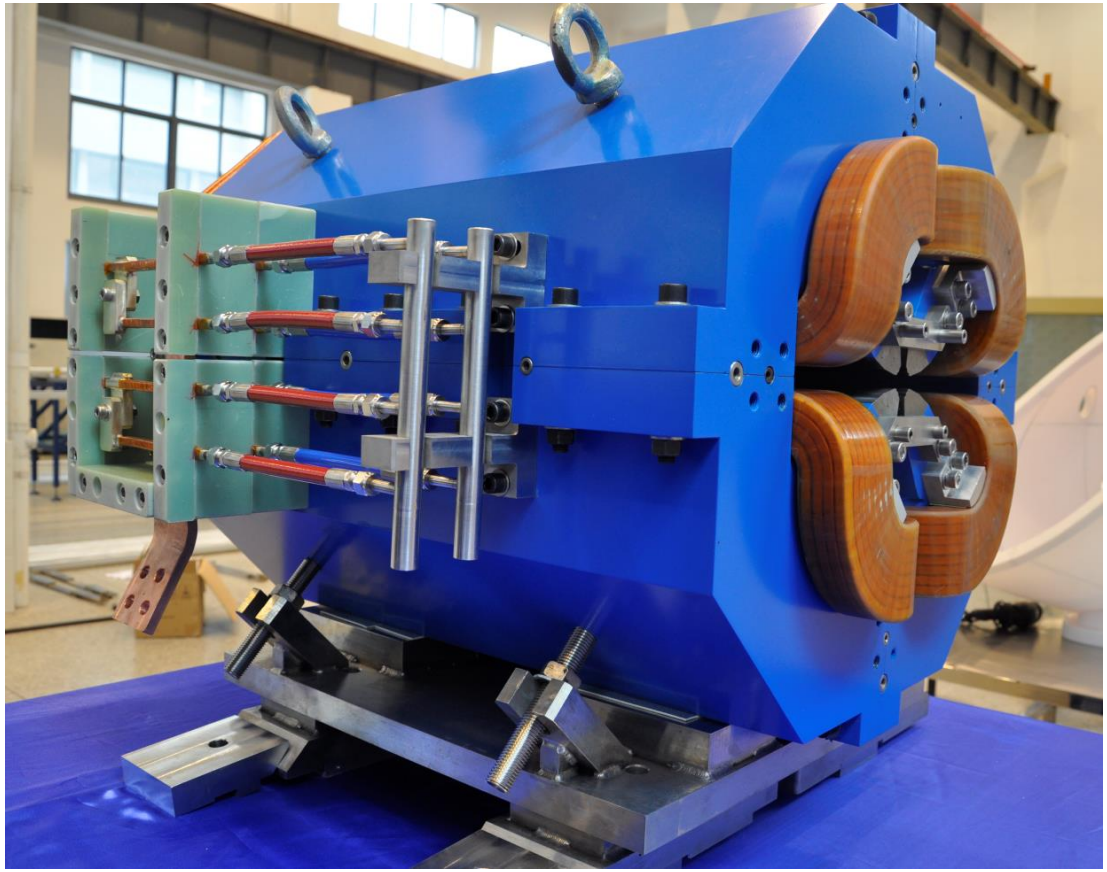


Cooperation of production and research of CEPC accelerator with Hefei KeYe

On December 27, focusing on the accelerator mechanical system, injection and extraction system, intensifier magnet, klystron, main ring magnet system, colliding zone superconducting magnet, linear equipment, detector superconducting magnet, vacuum system and other related contents, **Hefei KeYe with IHEP** made in-depth discussions and exchanges on CEPC requirements during the pre research period.

◆北京高能物理研究所-超高梯度四极铁I型

◆IHEP- - ultrahigh gradient quadrupole type I



超高梯度四极磁铁I型技术参数		
序号	技术指标	
1	有效长度（mm）	694
2	磁极孔径（mm）	25±0.02
3	磁场梯度（T/m）	80
4	极头曲面轮廓度（mm）	0.015
5	励磁电流（A）	161.3
6	导线尺寸（mm）	8×8-Φ5
7	电流密度（A/mm²）	3.7
8	水流速（m/s)	1.6
9	水路温升（° C）	5.5

◆HEPS增强器校正磁铁 HEPS Intensifier correction magnet

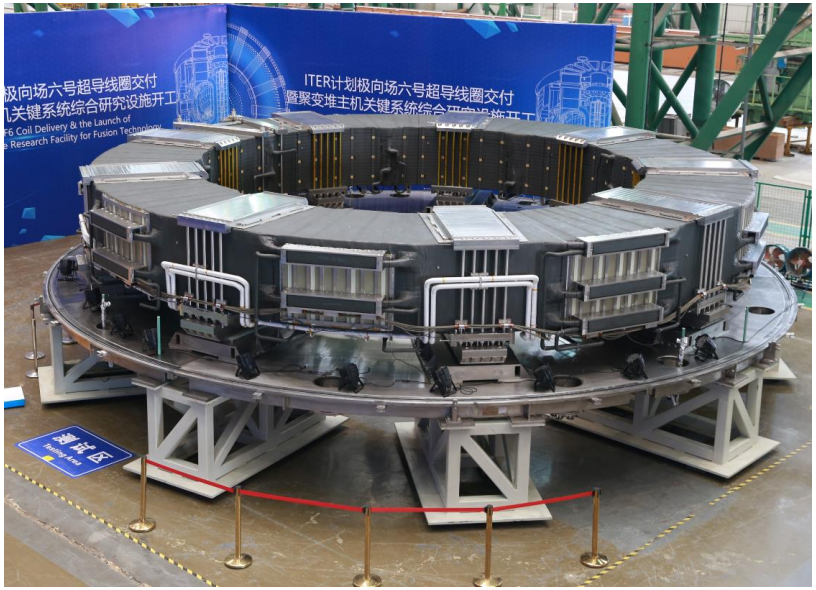
HEPS增强器校正磁铁总共有三种类型，BS-40CH 48台，BS-56CH 8台，BS-56CV 36台。校正铁为动态交流磁铁，铁芯采用冲片粘接结构，总装后极面气隙精度≤0.05mm，铁芯长度误差≤0.3mm，

HEPS增强器校正磁铁参数表				
参数名称	数值	数值	数值	单位
磁铁名称	BS-40CH	BS-56CH	BS-56CV	-
数量	48	8	36	-
磁有效长度	0.1500	0.1500	0.1500	m
最高工作磁场	0.06	0.06	0.06	T
磁极间隙	40	56	56	mm
好场区(H×V)	[-15,15]×[-15,15]	[-20,20]×[-20,20]	[-20,20]×[-20,20]	mm
好场区范围内场均匀度(@50Gs, 600Gs)	1×10^{-2}, 1×10^{-3}	1×10^{-2}, 1×10^{-3}	1×10^{-2}, 1×10^{-3}	-

◆BS-40CH磁铁实物图

◆ITER 组织-极向场PF6超导线圈制造

◆ITER-Fabrication of poloidal field PF6 superconducting coil



- PF6线圈直径约12米，高约2.8米；重约400吨；由9个绕制成双饼结构的线圈本体（NbTi超导导体）以及一系列支撑附件组成，线圈绕制所采用的NbTi超导导体长约13.5公里。PF6线圈是目前国际上研制成功的重量最大、难度最高的超导磁体。
- PF6 coil is about 12m in diameter and 2.8m high, and weighs about 400 tons. It is the largest and most difficult superconducting magnet in the world.

SHANGHAI PUSU TECH LTD.,CO
上海普束科技有限公司

主要从事**大型粒子加速器电磁铁**的研发、制造和装配，产品主要应用于核物理研究、粒子加速器研究、航天、核医学应用等领域。SHANGHAI PUSU provides design, precision machining and advanced manufacturing services **for electromagnet of accelerator**.

热处理二极磁铁

磁场强度0.3T

重量23吨

Magnet of Heat Treatment

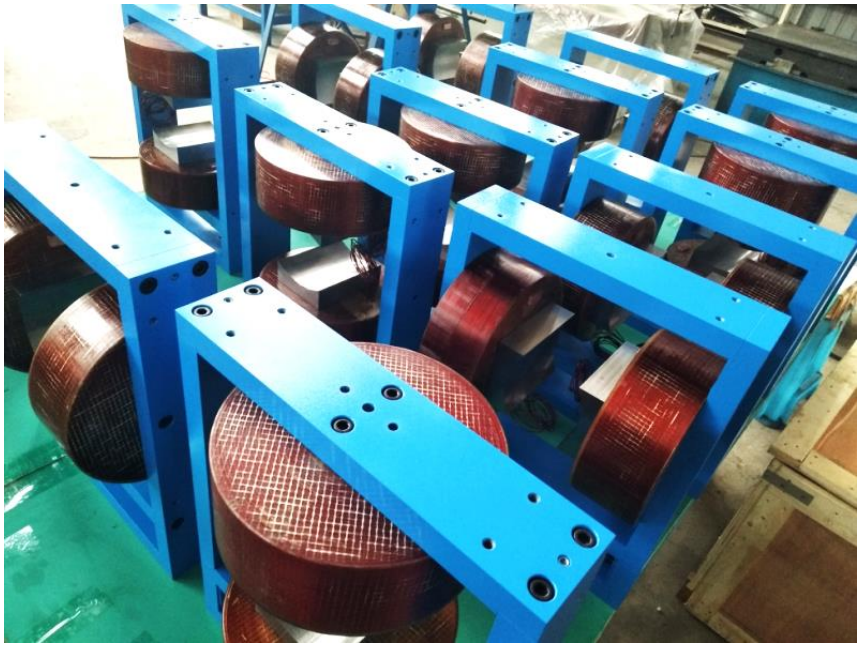
Magnetic field intensity: 0.3T

Weight:23 ton

SHANGHAI PUSU TECH LTD.,CO
上海普束科技有限公司

直线超导加速器束流运输系统新增磁元件项目四极磁铁

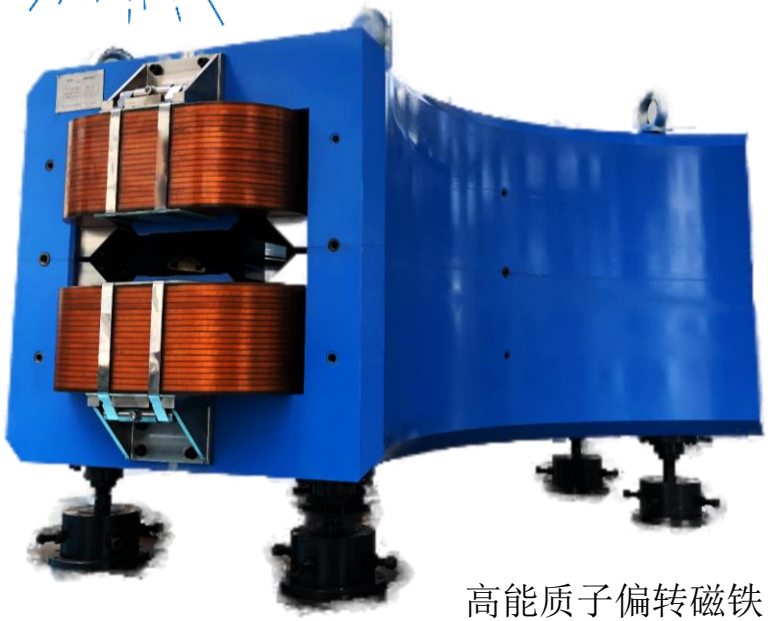
Beam transport system of linear superconductor Quadrupole magnet



直线超导加速器束流运输系统新增磁元件项目XY导向磁铁

Beam transport system of linear superconductor XY Guide Magnet

SHANGHAI PUSU TECH LTD.,CO
上海普束科技有限公司



高能质子偏转磁铁

偏转半径：1300mm

最大场强：1.3T;重量：12吨

High Energy Proton Deflection Magnet

Deflection radius: 1300mm

Magnetic field intensity: 1.3T

Weight:12 ton

中国科学院上海应用物理研究所X射线自由电子激光试验装置（简称SXFEL试验装置）

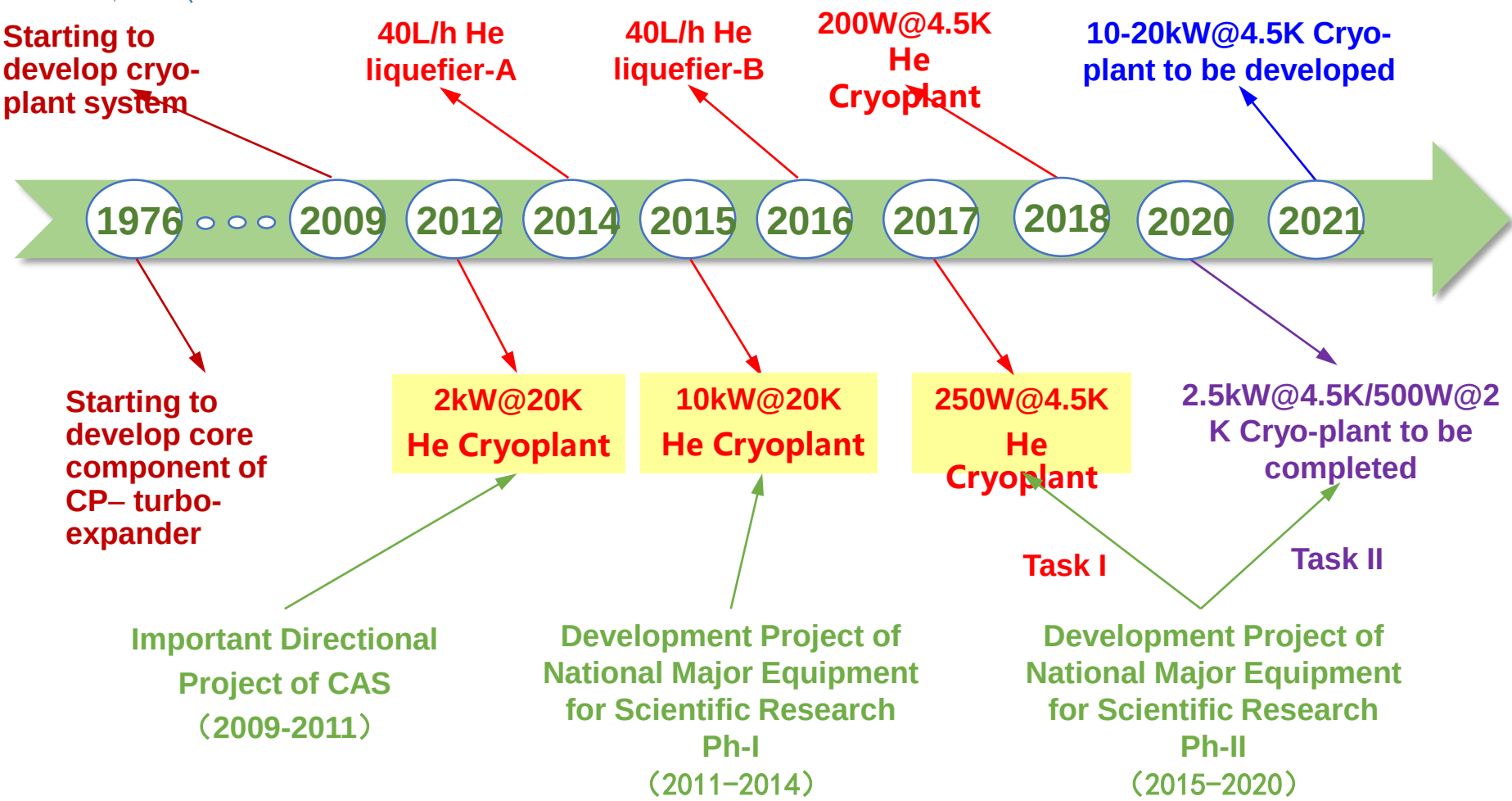
校正磁铁 69台

Soft X-ray Free-electron Laser (SXFEL) User Facility in Shanghai

Correcting magnet

Quantity: 69pcs

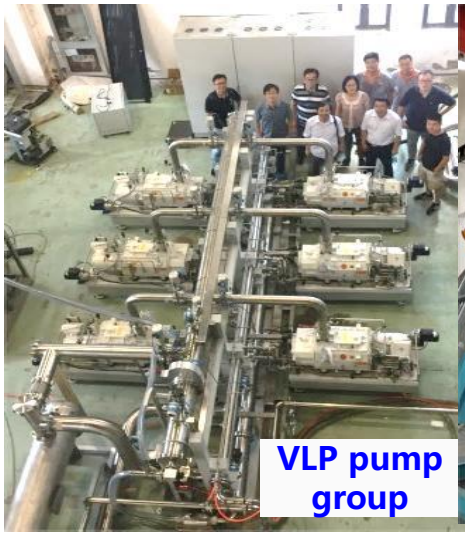
Development Journey of Helium Cryo-plant by TIPC & FULLCRYO in China



Development of Helium Cryo-plant of 2.5kW@4.5K / 500W@2K by TIPC & FULLCRYO

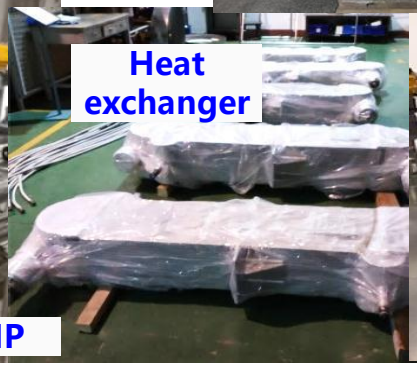
Key components or sub-systems


He compressor group


VLP pump group


ORS & GMP


Inner adsorbers

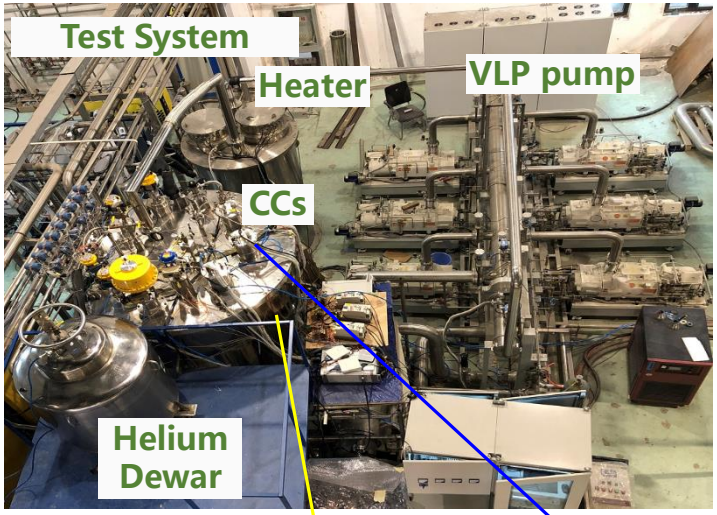

Heat exchanger


Cryogenic valves

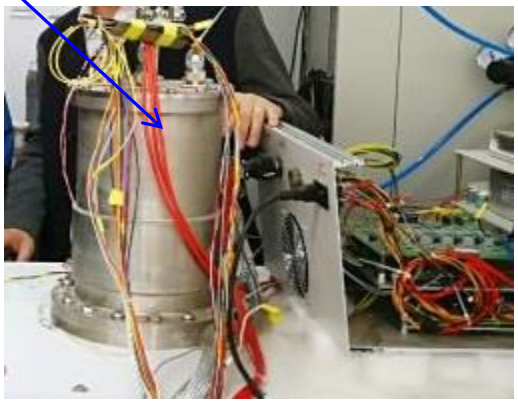

Cold Box

Development of Helium Cryo-plant of 2.5kW@4.5K / 500W@2K by TIPC & FULLCRYO

Core part of 2K sub-system: cold compressor

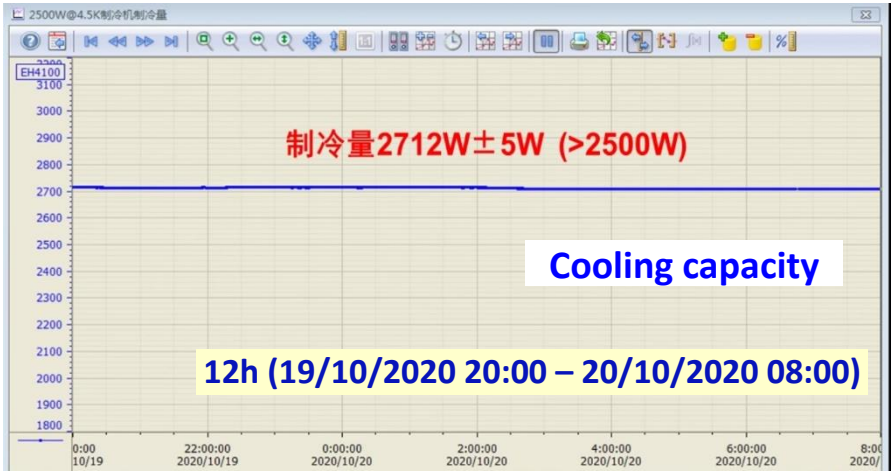


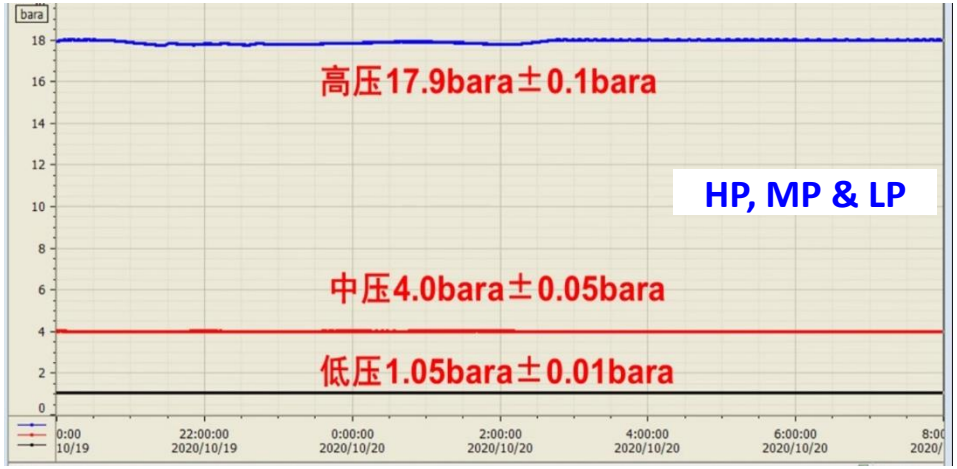
- Key technologies have been overcome: 1) kW class high-speed motor, 2) Magnetic bearing, 3) Thermal insulation under large T gradient, 4) Multi-stage CC coordination and anti-surge
- 04,2019：520W@2K，η > 61%
- The 4th unit in the world capable of developing and applying CC

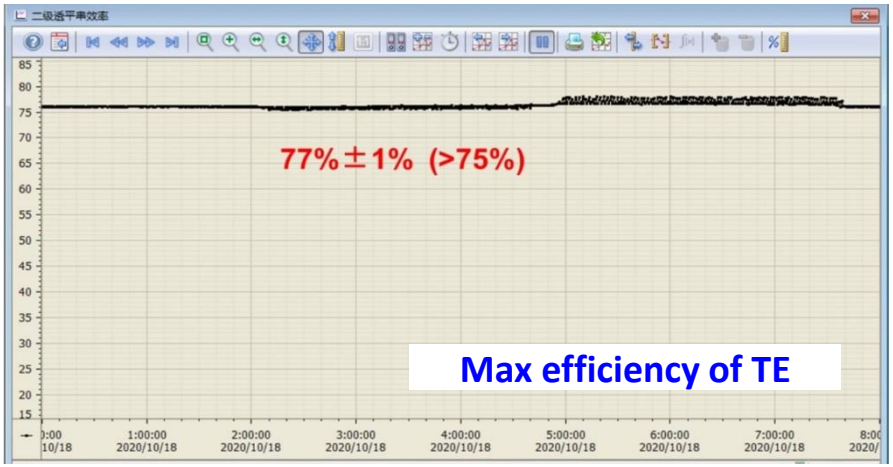


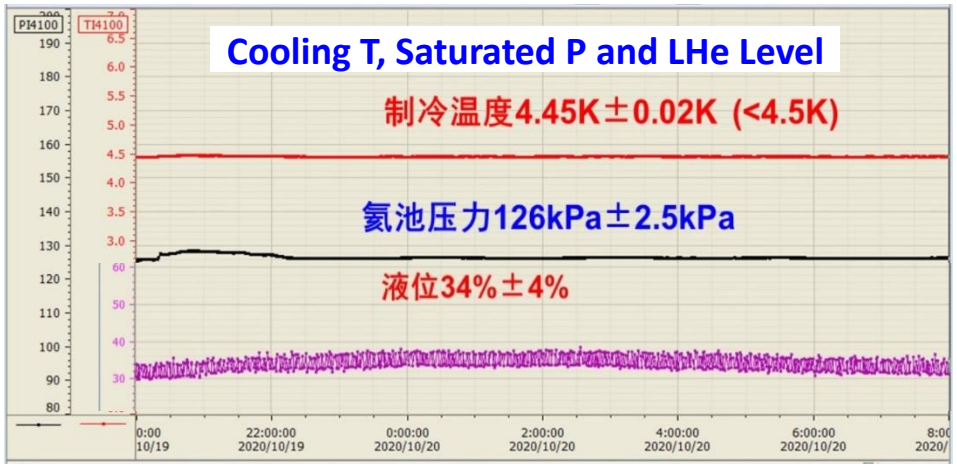
Development of Helium Cryo-plant of 2.5kW@4.5K / 500W@2K by TIPC & FULLCRYO

Progress – System test: Performance of 4.5K subsystem





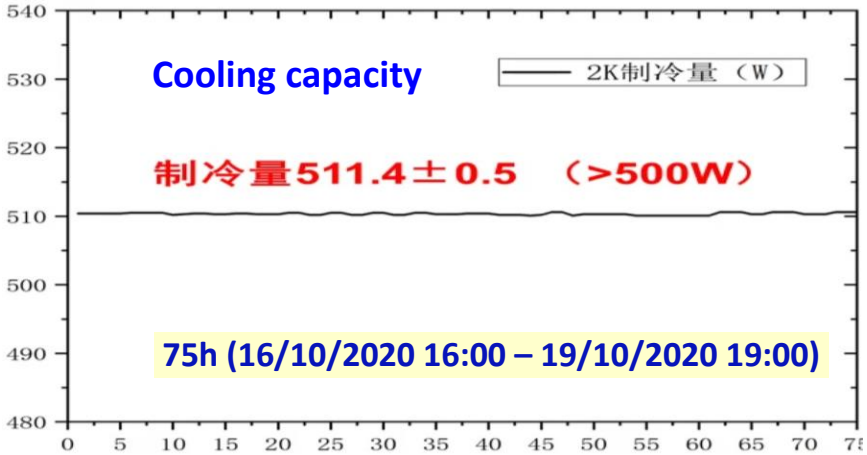


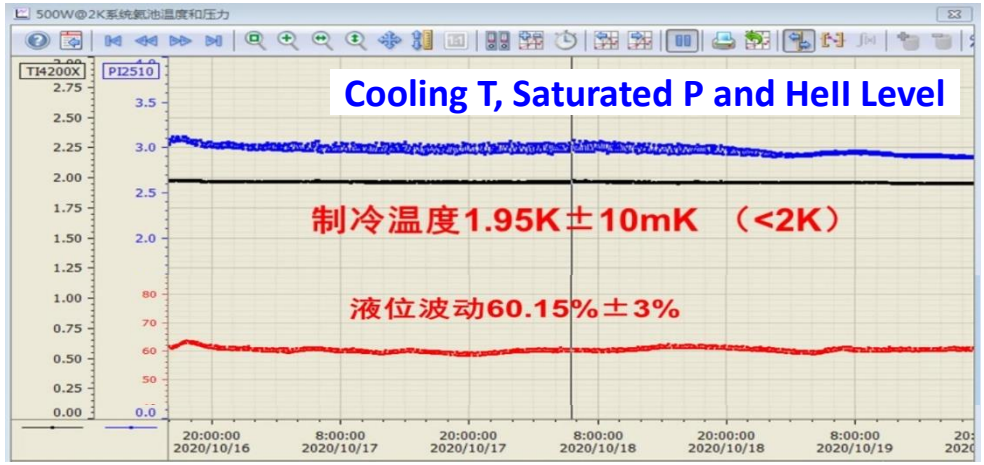


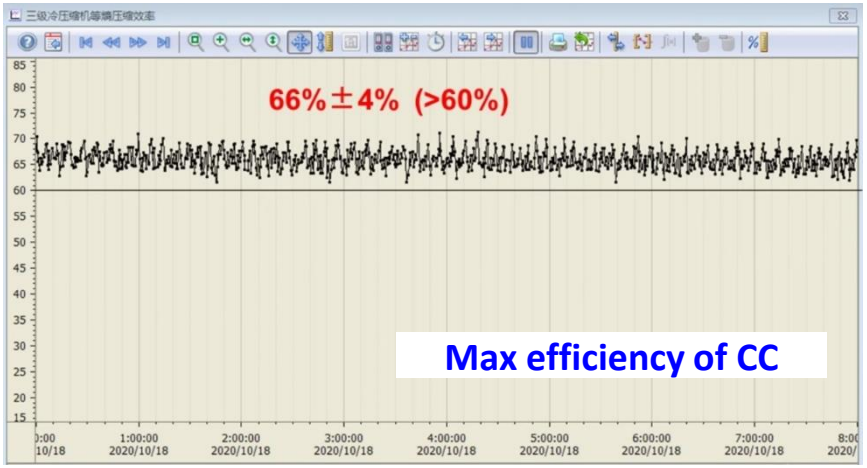
20K-2K large cryo-plant has reached the international advanced level

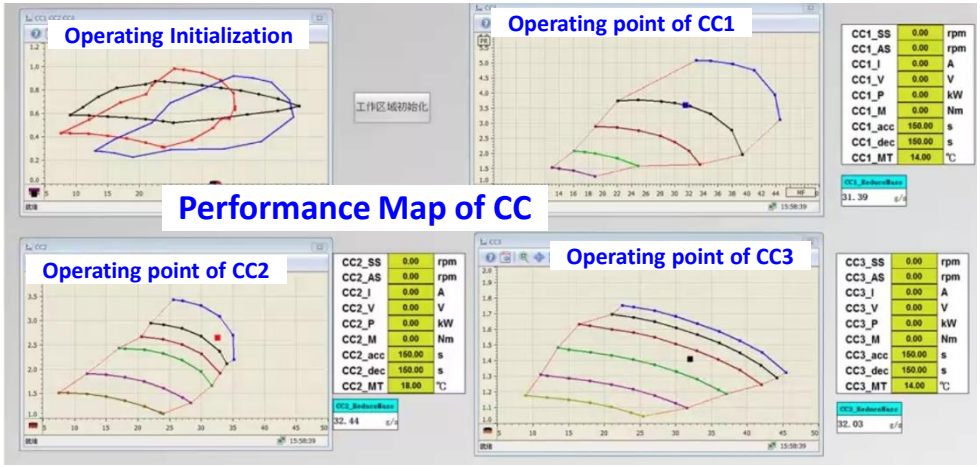
Development of Helium Cryo-plant of 2.5kW@4.5K / 500W@2K by TIPC & FULLCRYO

Progress – System test: Performance of 2K subsystem







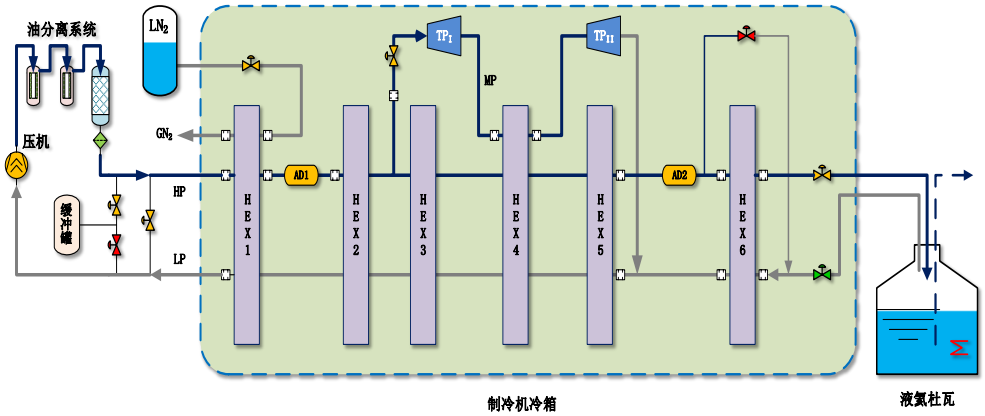


Capacity of from 20 to 2K and from 100W to kW helium cryo-plants in the world

Fullcryo Helium refrigerator

氦液化器系列	FHL-40	FHL-70	FHL-100	FHL-140	FHL-180	FHL-240	FHL-280
液化率 L/h	40~70	70~100	100~140	140~180	180~240	240~280	280~310
压缩机额定功率 kW	75~90	90~132	132~160	160~200	200~250	250~315	315~355

氦制冷机系列	FHR-40	FHR-70	FHR-100	FHR-140	FHR-180	FHR-240	FHR-280
制冷量 W	160 ~250	250~320	320~450	450 ~580	580~750	750 ~900	900 ~1000
压缩机额定功率 kW	75~90	90~~132	132~160	160~200	200~250	250~315	315~355

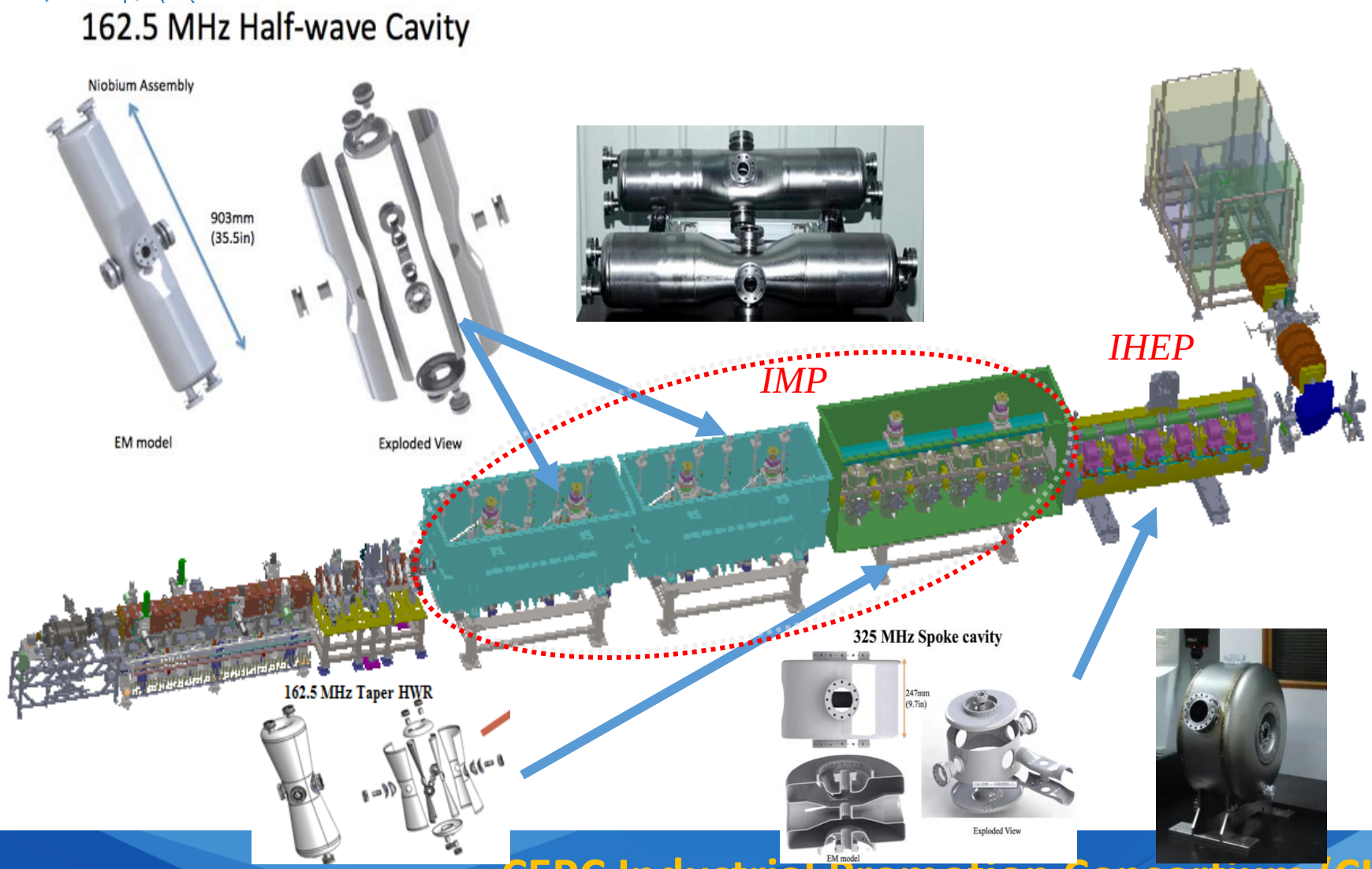


Cryogenics Collaboration

Industrial Promotion Consortium (CIPC)

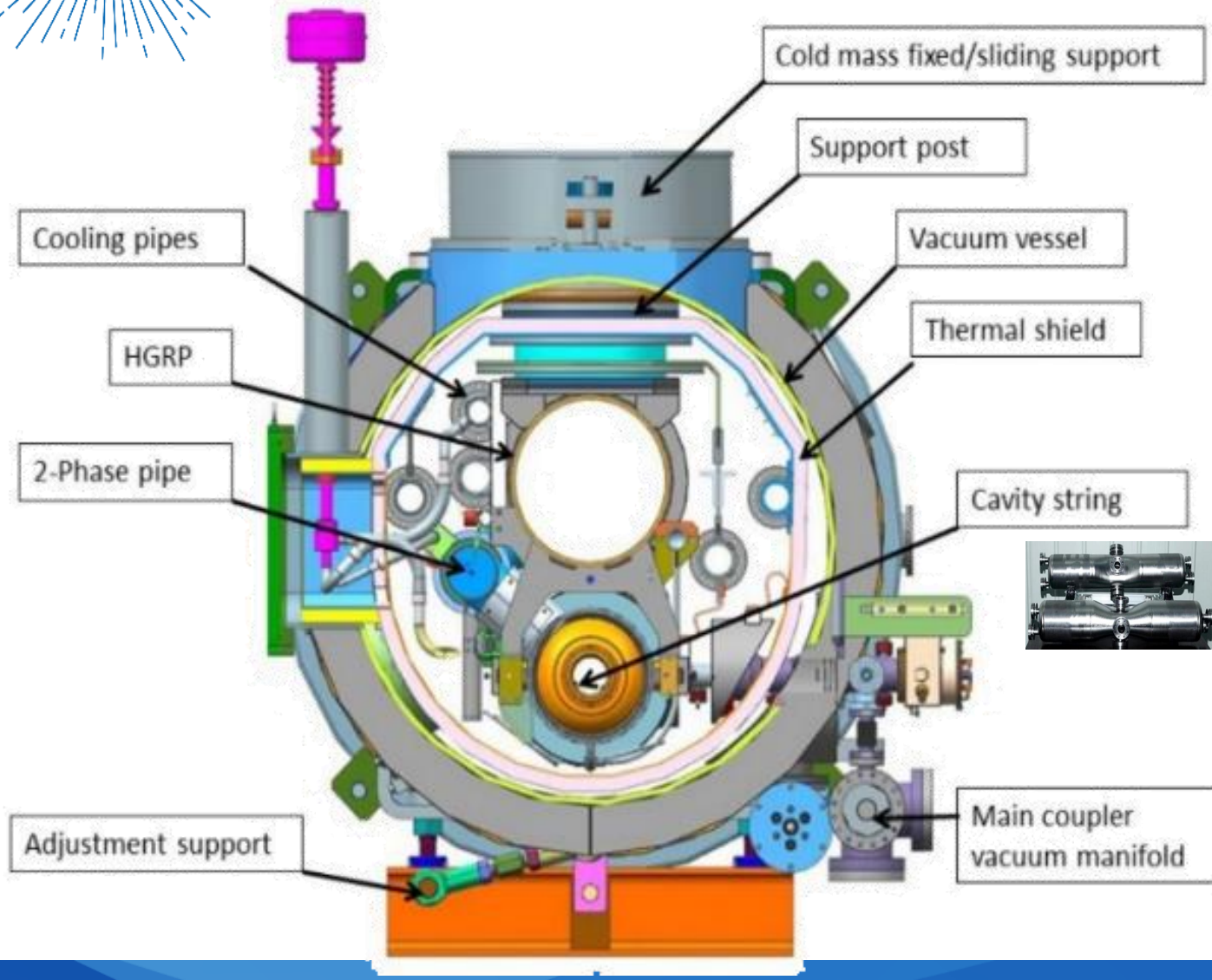
Cryogenic Infrastructure for Superconducting Accelerator

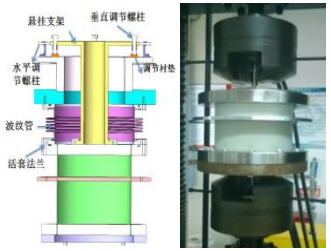
- ***Cryomodule（for example）*** *IMP &IHEP Cryomodule*

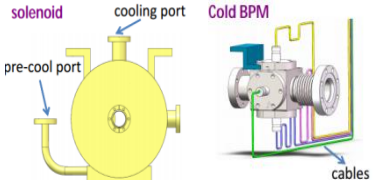


Cryogenic Infrastructure for Superconducting Accelerator

■ Cryomodule







Sichuan Jiutian Vacuum Technology Co., Ltd

CBVAC 九天真空

真空阀门 Vacuum valve（军工、航天、科研）

产品最全，口径范围全覆盖，并能提供非标真空阀门的定制化服务。

全系列真空挡板阀

全系列真空插板阀

新型冲压壳体真空插板阀

定制矩形真空插板阀（含水冷型）

侧驱动真空插板阀

Sichuan Jiutian Vacuum Technology Co., Ltd

CBVAC 九天真空

九天真空为航天、科研单位提供的各类型环模系统
Various types of environmental simulation systems for aerospace and scientific research institutions



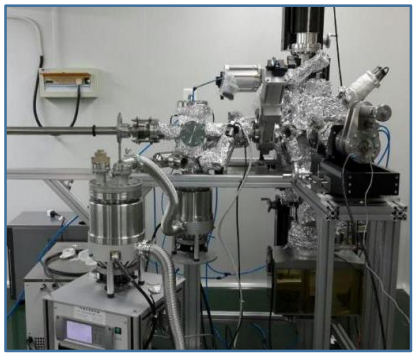





上海夯业真空设备科技有限公司

H-VAC Technology Co., Ltd.

产品和服务, Products and Services	
非标设计和制造服务 Custom Design and Manufacture	真空腔室和系统，Chamber and System
	真空钎焊, Vacuum Brazing
真空镀膜系统 Film Deposition System	磁控溅射，Sputter Deposition
	真空蒸镀，Vacuum Evaporation
微波器件 Microwave Devices	微波加速管，RF Accelerating Units
	波导元件，Wave-guides
	能量倍增器，Energy Doublers
带电粒子束线和部件 Charged Particle Components and Beam Line	电子枪，Electron Gun
	离子源，Ion Source
	束线，Beam Line



沈阳科仪
SKY TECHNOLOGY DEVELOPMENT

主要产品系列
Main product series

真空科研设备
Vacuum research equipment


CVD设备


真空互联设备


PVD设备

高端装备
Equipment


蓝宝石晶体生长炉


电子束蒸发镀膜系统（3种）


直拉法蓝宝石炉

真空干泵
Vacuum dry pump


LED/光伏干泵机组


涡旋干泵

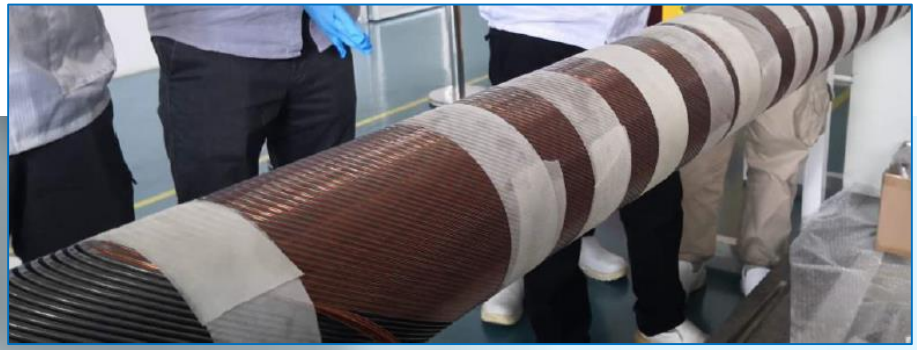

系列干泵

核心部件
Core components

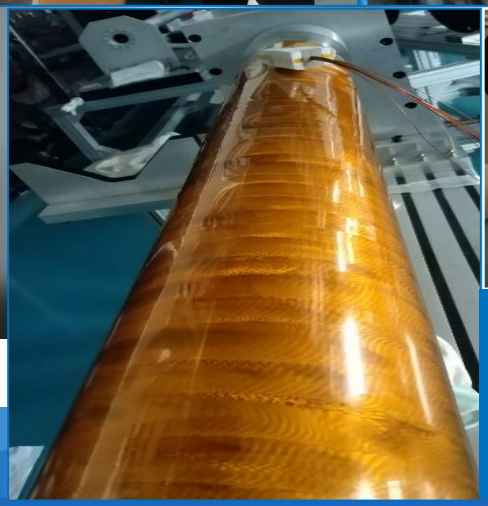
Key Strength

Superconductor Technology
苏州八匹马超导科技有限公司

- 10+ years experience in high quality superconducting magnetic product R/D and manufacturing for MRI and semiconductor industry
- 10+ years experience in customized superconducting magnet design and engineering for scientific research
- 10+ years experience in cryogenic product development and integration



Wet winding with CTD-101K, pre-curing, and 5-bar VPI

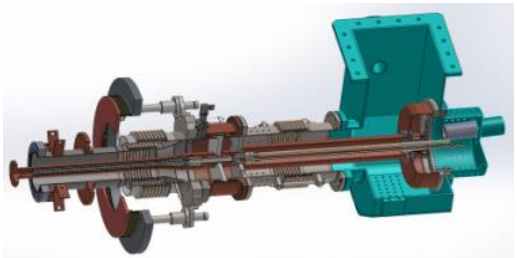
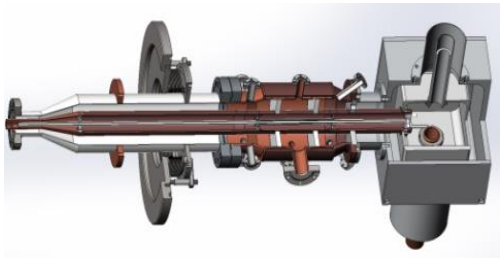
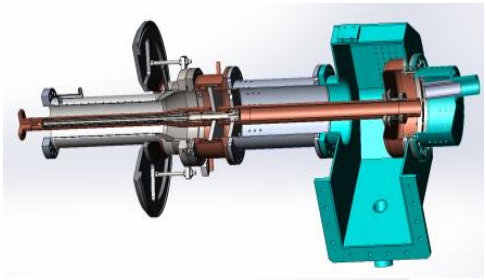
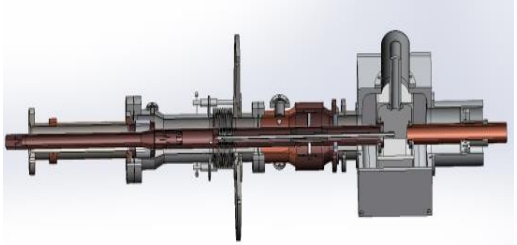
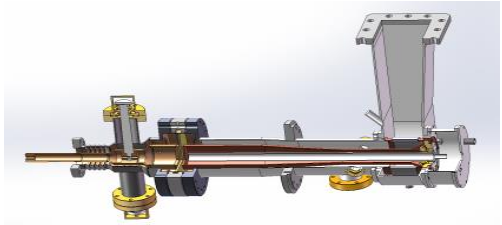
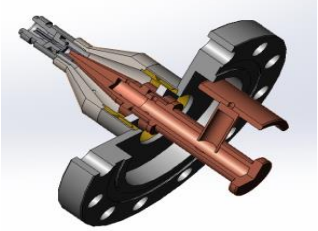


Outer support tube and VPI tooling installation completed

Coupler - Anhui east China Optoelectronic Technology Research Institute Co., Ltd

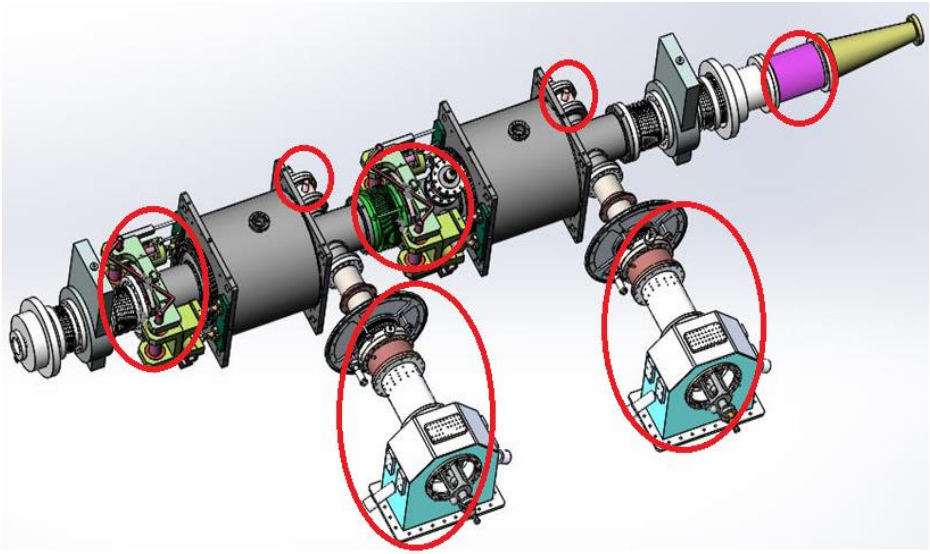
Coupler products developed since 2015

- IMP: 162.5mhz double hot window coupler, cold and hot double window coupler
- Peking University: 1.3GHz coupler
- IHEP: 650MHz coupler, 650MHz high order mode coupler
- Shanghai Institute: research and manufacturing of 1.3GHz high power input coupler and some coupler components.

Anhui HuaDong Optoelectronic Technology Research Institute Co., Ltd

Production and manufacturing experience of high-power coupler, high-order mode coupler, tuner, high-order mode absorber, BPM, kicker and other products, as well as the production and manufacturing capacity of related special-shaped continuous cavity transition and other ancillary products.



CEPC 650MHz 高功率耦合器测试报告

2020 年 7 月 7 日，中国科学院高能物理研究所组织测试专家对国家重点研发计划项目“高能环形正负电子对撞机相关的物理和关键技术预研究”课题“加速器关键技术预研”研制的 CEPC 650MHz 高功率耦合器进行了高功率测试。测试专家组由来自中国科学院高能物理研究所、中国原子能科学研究院、北京大学的专家组成（名单见附件 1）。

测试专家组首先听取了项目组对 CEPC 650MHz 高功率耦合器测试方案的汇报，考察了测试装置，然后对 2 只 650MHz 高功率耦合器进行了现场测试，结果如下：

驻波测试过程中，两只高功率耦合器均通过了连续波 80 kW，且通过移动终端短路活塞，确保波腹点覆盖耦合器所有微波面，等效于行波下连续波 320 kW 的高功率测试。

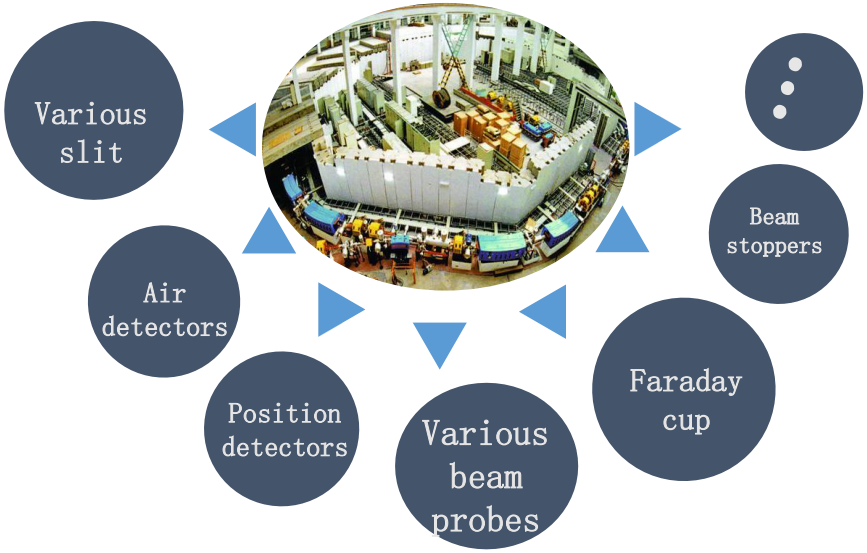
测试专家组组长：
测试专家组组员：
日期：2020.07.07

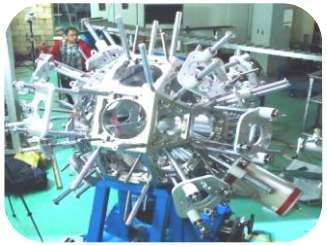
Shenyang Huiyu Vacuum Technology CO,LTD

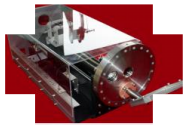
沈阳慧宇真空技术有限公司

Products in Modern Physics Institute(CAS)

Various beam probes, Faraday Cup, single-wire detectors, twin-wire detectors, air detectors, position detectors, phase probes, radial probes, stripping targets, various slit, beam stopper etc.







Shenyang Huiyu Vacuum Technology CO,LTD

沈阳慧宇真空技术有限公司

Highlight progress of vacuum equipment for CEPC

Highlight progress in 2020：

- High vacuum equipment
  - ⇒ Chamber: Φ380mm*420mm
  - ⇒ Vacuum : >10^{-5}
  - ⇒ Control interface
  - ⇒ Self-lifting device with quartz window
  - ⇒ Two-stage vacuum design
- New materials testing for CEPC
  - ⇒ Common chamber for material mountain
  - ⇒ High Voltage integration (6000V)
  - ⇒ Material support framework
  - ⇒ Different materials to testing

Vacuum equipment for material testing

Application of high precision measurement technology in Five-hundred-meter Aperture Spherical radio Telescope (FAST)

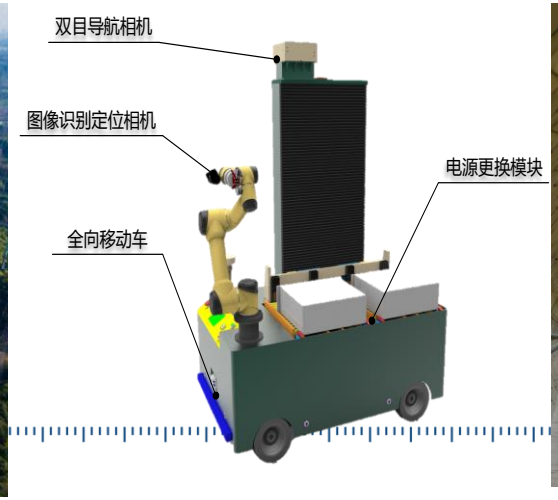
500米口径射电望远镜（FAST）：面型大、测量精度高、实时性强、馈源高动态

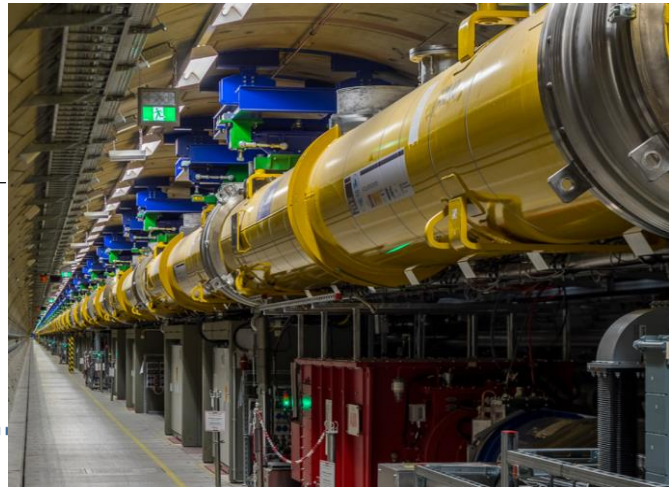
- Unit panel measurement (4450 blocks): automated Photogrammetry
- Node measurement of reflector (2250): 72 total stations (adjustment, large elevation difference and meteorological condition difference affect the measurement accuracy and require high algorithm model)
- Feed support: solve the problem that multiple total station can't measure synchronously by algorithm

Application of high precision measurement technology in SHINE

上海硬X射线自由电子激光装置：环境高危、有辐射、范围大、自动化程度高

- Using photogrammetry technology and laser tracker to establish high-precision collimation datum, the accuracy is 0.2 mm in 400 meters.
- A large-scale and high-precision automatic measurement and control network is established to realize automatic measurement and maintenance based on robot.





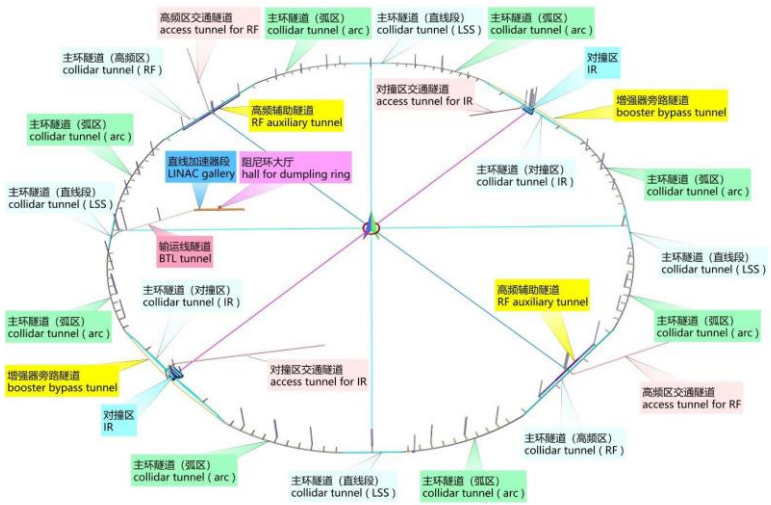
Application of high precision measurement technology in CEPC

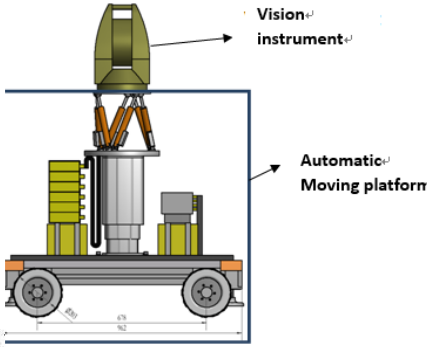
Difficulties:

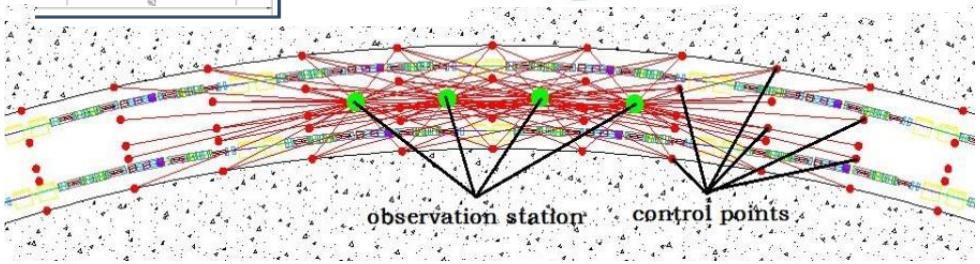
- Distance: 100 km
- Many control and measurement points: up to millions
- High precision: 0.2mm

"More than three demands"

- There are many methods, instruments and stations
- Urgent need for new measurement solutions







CEPC alignment installation cooperation group established

- On April 8, 2020 the first academic exchange meeting was on the Internet by the CEPC collimation and installation cooperation group. CEPC alignment installation cooperation group was officially established.
- Changchun Institute of Optics and mechanics, institute of Surveying and mapping of Wuhan University, and Beijing PDADITAI Technology Co., Ltd. respectively introduced the relevant scientific research and technological strength and development achievements of their respective units. The head of the Overseas Chinese University, reported on the research progress of CEPC warehouse and installation process planning. All partners indicated that they should contribute to the TDR and construction of CEPC.
- Relevant persons in charge of the Yellow River survey, planning and Design Institute Co., Ltd., HuaDong Survey and Design Institute Co., Ltd., and Central South Survey and Design Research Institute Co., Ltd. also attended the meeting.

Cooperation of production and research of CEPC

High Energy Institute and overseas Chinese University carry out cooperation on the Internet of things technology, big data and artificial intelligence.

Cooperation with **Quanzhou digital cloud Valley Information Industry Development Co., Ltd**
Support the "cepc warehouse planning and process virtual simulation project" with "cloud Valley capability".

CEPC Accelerator related Domestic Collaboration

On CEPC accelerator many systems, we also have carried out in-depth collaborative design and pre research work with enterprises.

- CEPC 650MHz high efficiency klystron (Kunshan national power,IECAS, HE-Racing,etc.);
- MDI Design/Assembly machinery (Shenyang Hui Yu,Chinese Aerospace Academy, etc.);
- SCRF (Anhui Huadong,Shanghai Sanjing vaccum, Beijing Fu Bin Sheng Shi Vacuum,etc.)
- Superconducting magnet (Wuxi Tongli, Shanghai Pushu, Hefei,etc.).
- Cryogenics (Fullcryo, Vacree, Pengli, Wuxi, Hefei KeYe,etc.)
- Vaccum(Shanghai Vacuum ,Chuanbei Vaccum, Shenyang Hui Yu,Hefei Keye)
- CEPC site selection, civil engineering and Science Town Planning (Yellow River Conservancy Commission, HUADONG ENGINEERING CORPORATION LIMITED, JiLin University, etc.).
- Etc.

CIPC at this Workshop:
35 reports and about 80 attendee

Monday 26 November 2020

Monday, October 26, 2020

08:30 - 10:00 CIPC

Convener: Yongming 李永明 Li (昆山国力真空电器有限公司)

Location: Grand Ballroom C (Online Meeting Room: https://weidijia.zoom.com.cn/j/62874286168)

- 08:30 **Klystron** *15'*
  Speaker: 少哲 王 (昆山国力大功率器件工业技术研究院)
- 08:45 **(Klystron) Circulator&load** *15'*
  Speaker: 立强 王 (航天二院二十三所)
- 09:00 **Klystron** *15'*
  Speaker: 瑞 张 (中科院空天信息研究院)
- 09:15 **(CEPC magnet) Collider, booster and linac magnets** *15'*
  Speaker: 旭文 戴 (高能锐新)
- 09:30 **(CEPC magnet) Company introduction** *15'*
  Speaker: 明涛 康 (上海普束科技有限公司)
- 09:45 **(CEPC magnet) CEPC booster magnet** *15'*
  Speaker: 光亮 朱 (合肥科烨电物理设备制造有限公司)

10:00 - 10:30 Break

10:30 - 12:00 CIPC

Convener: Dawei 刘大炜 Liu

Location: Grand Ballroom C (Online Meeting Room: https://weidijia.zoom.com.cn/j/62874286168)

- 10:30 **(CEPC magnet) CEPC collider ring dual aperture quadrupole** *15'*
  Speaker: 大鹏 尹 (合肥科烨电物理设备制造有限公司)
- 10:45 **(Electro-magnet seperator)** *15'*
  Speaker: 盘林 郭 (上海夯业真空设备科技有限公司)
- 11:00 **(CEPC SC magnet)0.5mm NbTi超导股线** *15'*
  Speaker: 维涛 刘 (西部超导材料科技股份有限公司)
- 11:15 **(CEPC SC magnet)0.5m超导四极磁体QD0短样机制造** *15'*
  Speaker: 艺 万 (合肥科烨电物理设备制造有限公司)
- 11:30 **(CEPC MDI)** *15'*
  Speaker: 涛 孙、洪清 吕 (无锡创新低温环模设备科技有限公司)

12:10 - 14:00 Lunch

14:00 - 16:00 CIPC

Convener: Ming 李明 Li

Location: Grand Ballroom C (Online Meeting Room: https://weidijia.zoom.com.cn/j/62874286168)

- 14:00 **CEPC MDI** *15'*
  Speaker: 绍栋 何 (北京空间机电研究所 (航天508所))
- 14:15 **(SCRF)Linac structure and SCRF cavity fabrication** *15'*
  Speaker: 旭文 戴 (北京高能锐新公司)
- 14:30 **SCRF** *15'*
  Speaker: 众 李 (otic)
- 14:45 **SCRF** *15'*
  Speaker: 海根 邵 (安徽华东光电技术研究所有限公司)
- 15:00 **SCRF** *15'*
  Speaker: 承业 郑 (N)
- 15:15 **SCRF** *15'*
  Speaker: 文清 李 (北京富斌盛世真空设备有限公司)
- 15:30 **Vacuum** *15'*
  Speaker: 东林 章 (shzkvalve)
- 15:45 **Vacuum** *15'*
  Speaker: 宇 蔺 (川北真空科技 (北京) 有限公司)

16:30 - 18:30 CIPC

Convener: Liqiang 刘立强 Liu (北京中科富海低温科技有限公司-中国科学院理化技术研究所)

Location: Grand Ballroom C (Online Meeting Room: https://weidijia.zoom.com.cn/j/62874286168)

- 16:30 **Vacuum** *15'*
  Speaker: 易晓 关 (SKY)
- 16:45 **(Vacuum) 超高真空全金属阀门研究开发** *15'*
  Speaker: 魁榜 张 (四川九天真空科技股份有限公司)
- 17:00 **Cryogenics** *15'*
  Speaker: 立强 刘 (北京中科富海低温科技有限公司-中国科学院理化技术研究所)
- 17:15 **Cryogenics** *15'*
  Speaker: 家屿 周 (安徽万瑞冷电科技有限公司)
- 17:30 **Cryogenics** *15'*
  Speaker: 文 董 (中船重工鹏力 (南京) 超低温技术有限公司)
- 17:45 **Cryogenics** *15'*
  Speaker: 洪清 吕 (W)
- 18:00 **Cryogenics** *15'*
  Speaker: 杰峰 吴 (合肥聚能电物理高技术开发有限公司)
- 18:15 **Cryogenics** *15'*
  Speaker: 大明 孙 (江苏克劳特低温技术有限公司)

Tuesday 27 November 2020

08:30 - 10:00 CIPC

Convener: Daming孙大明 Sun (Zhejiang University)

Location: Grand Ballroom C (Online Meeting Room: https://weidijia.zoom.com.cn/j/65618631886)

08:30 **Instrumentation** *15'*
Speaker: 海根 邵 (华东光电研究院)

08:45 **Instrumentation** *15'*
Speaker: 子燕 谢 (浩德科仪真空技术有限公司)

09:00 **Instrumentation** *15'*
Speaker: 顺和 于 (沈阳科学仪器厂)

09:15 **Radiation protection** *15'*
Speaker: 龙 张 (北京市射线应用研究中心)

09:30 **Radiation protection** *15'*
Speaker: 泽学 郭 (天津市万木辐射防护工程有限公司)

09:45 **(Mechnics)介绍公司情况** *15'*
Speaker: 宝瑞 刘 (北京空间机电研究所 (航天508所)

10:30 - 12:00 CIPC

Convener: Shenghong 范生宏 Fan (北京普达迪泰科技有限公司)

Location: Grand Ballroom C (Online Meeting Room: https://weidijia.zoom.com.cn/j/65618631886)

10:30 **(Mechnics) MDI远程真空连接设计** *15'*
Speaker: 奇 杨 (沈阳慧宇真空技术有限公司)

10:45 **(Mechnics)隧道磁铁、支架等设备运输车辆** *15'*
Speaker: 超 孙 (北车618所)

11:00 **(Alignment)非接触式精密测量和智能视觉系统** *15'*
Speaker: 生宏 范 (北京普达迪泰科技有限公司)

11:15 **(Alignment)精密基准件研制** *15'*
Speaker: 长河 朱 (汉中远航精密机械制造有限公司)

11:30 **(Alignment)高分辨率对地观测系统、机械设计、系统集成** *15'*
Speaker: 兴泽 王 (中国空间技术研究院总体部)

11:45 **(Alignment)精密光电测量系统** *15'*
Speaker: 维虎 周 (中国科学院微电子所)

14:00 - 16:00 CIPC

Convener: Jidong孙继东 Sun

Location: Grand Ballroom C (Online Meeting Room: https://weidijia.zoom.com.cn/j/65618631886)

14:00 **(Alignment)大地测量 , 工程测量** *15'*
Speaker: 宣斌 姚/进贵 邹 (武汉大学 测绘学院)

14:15 **CEPC地质研究** *15'*
Speaker: 祥金 冉 (Jilin University)

14:30 **Installation and store** *15'*
Speaker: 佳斌 王 (华侨大学)

14:45 **SppC magnet** *15'*
Speaker: 建伟 刘 (西部超导)

15:00 **SppC magnet** *15'*
Speaker: 跃 赵 (上海超导)

15:15 **SppC magnet** *15'*
Speaker: 传兵 蔡 (上海大学/上创超导)

15:30 **SppC magnet** *15'*
Speaker: 和安 廖 (统力电工)

15:45 **(SppC magnet)HL-LHC CCT磁体进展** *15'*
Speaker: 洪明 汤 (shangcitech)

Summary

- More than 30 companies have presented the reports in this Workshop in reviewing the work that were done in CDR/TDR stage and current progress/future plan. It needs more and more participation and support from enterprises.

- Up to now, more than 70 enterprises have participated in CIPC in 2020. In the future, it will further expand the scale and coverage of CIPC member units, and strengthen the pre research cooperation between research and design teams and enterprises.

- In the TDR stage of CEPC, work together with the accelerator and detector team to complete the TDR task target of CEPC as planned in 2022, and prepare for the industrialization of CEPC engineering construction from 2022 to 2030.

Thank you for your kind attention

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