



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.

Accelerating Equipments Development at IHEP&HERT

NOV.,7th @Guangzhou,China

The 2025 international workshop on the high energy Circular Electron Positron Collider (CEPC)

zhangzj@ihep.ac.cn; +8613810771939.



Outline



Brief Introduction



Magnets



Accelerating Structure and RT Cavities



SRF Cavities Couplers and Cryomodules



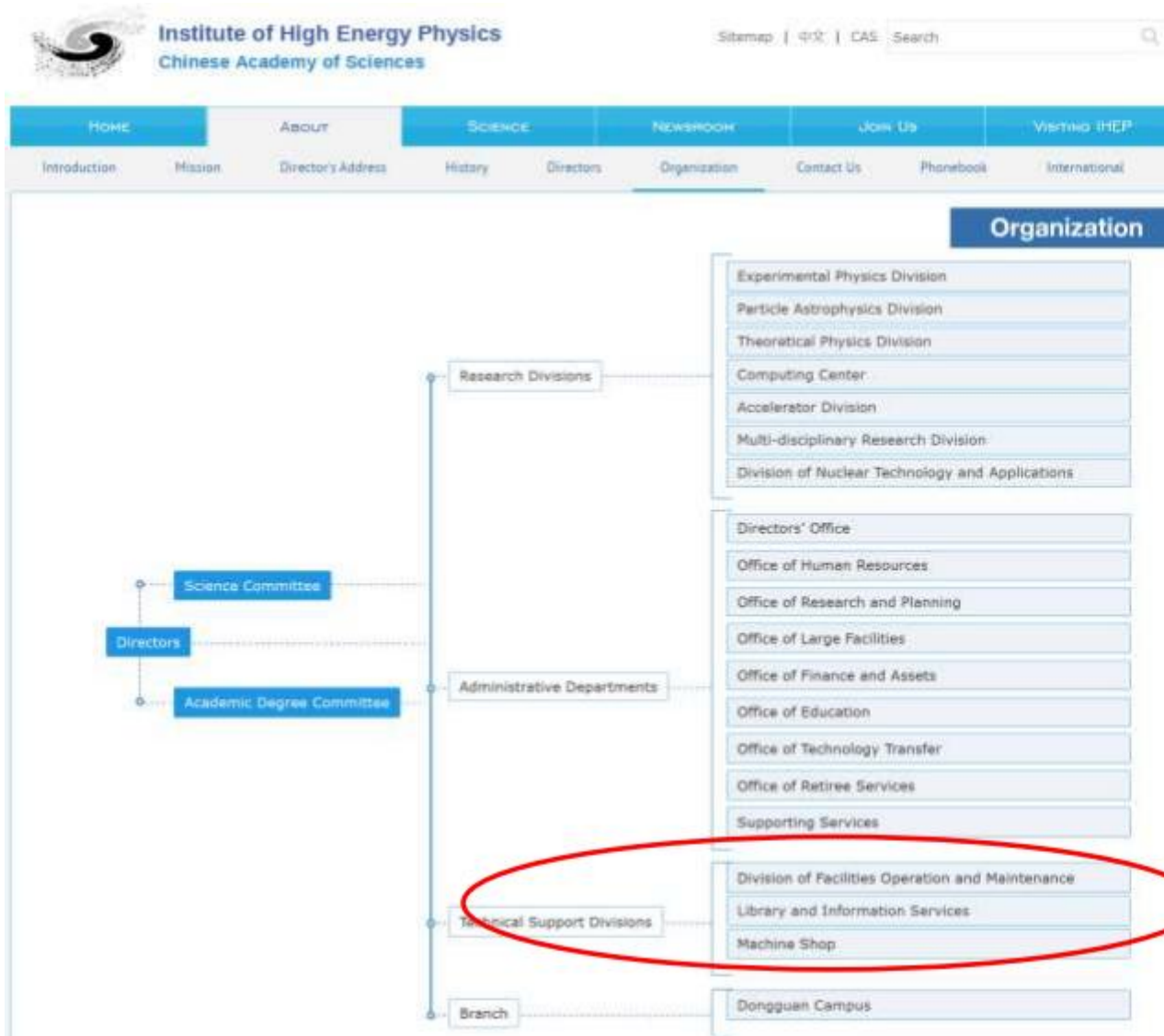
Facilities Serviced by HERT



Summary

1. Brief Introduction

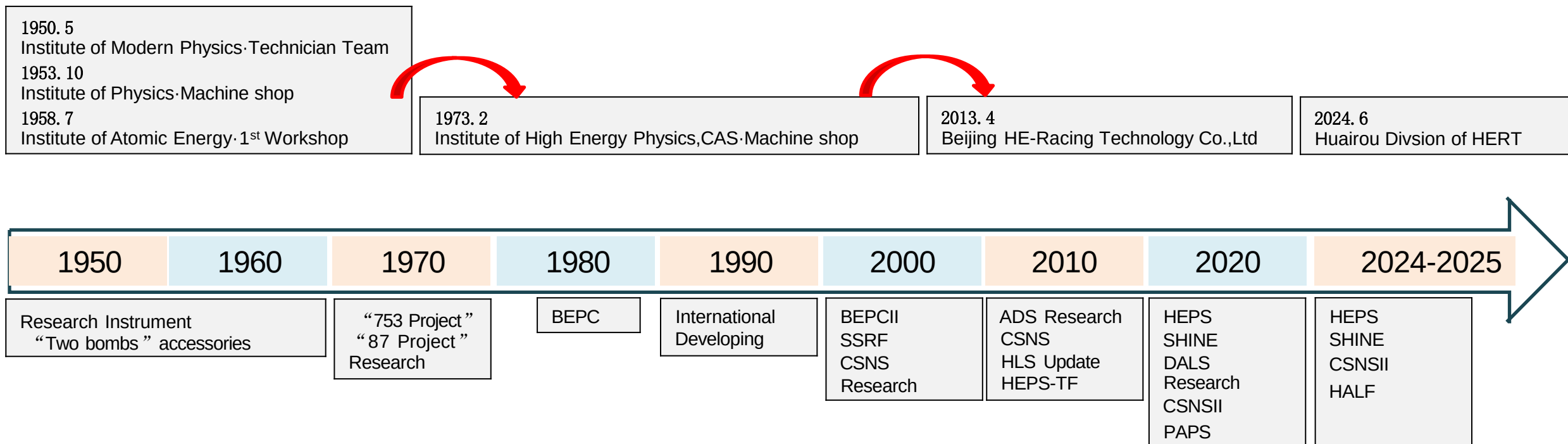
■ IHEP organization



- In year 2013, the company (HERT) was established.
- The company is wholly owned by IHEP.
- Be responsible for the international development cooperation.

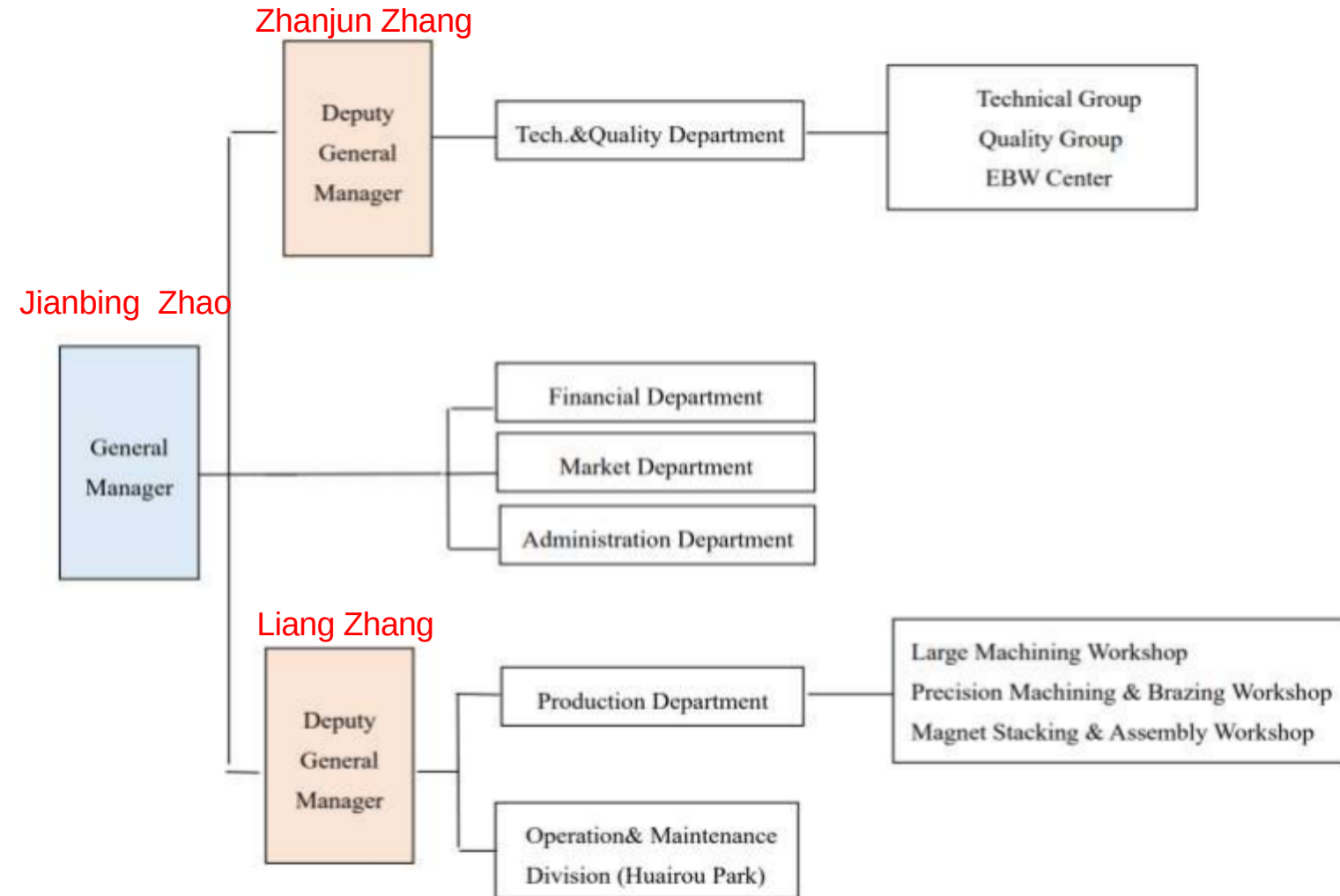
1. Brief Introduction

■ History



1. Brief Introduction

■ HERT Organization



- The company has 120 staff members in total. 20 of them are IHEP employees.
- Jianbing Zhao, Liang Zhang and I are IHEP employees.

1. Brief Introduction

■ Main Products:

- Magnets
- Accelerating Structure and RT Cavities
- SRF Cavities, Couplers and cryomodules.
- Insertion Devices
- Microwave devices
- RFQ and DTL
- SLEDs

1. Brief Introduction

■ Project and Experience:

- ◆ BEPC/BEPCII, CSNS, SSRF, HEPS-TF, HLSII, THz, DCLS, SXFEL, CADS, SHINE, HEPS, DALS, HALF, CSNSII ...
- ◆ PLS/PLSII, PAL-FEL, PEFP, KEK-B, FIR/THz, RISP ...
- ◆ PEPII, SPEAR3, NSLSII, CLS, ILC-ATF2, LCLSII ...
- ◆ SPARK, LEG, E-XFEL, MAXIV, FERMI-Eletta, KIPT-ADS ...

1. Brief Introduction

■ Machining Tools and Equipment:

(Total >500 sets)

编号	设备名称	品牌	型号	主要技术指标 (行程 (精度)) mm	数量
1	加工中心	山崎马扎克	LGMazak	X/Y/Z:1050×510×560 (0.008)	1
2	加工中心	哈斯	VF6	X/Y/Z:1626×813×762 (0.01)	1
3	加工中心	沈阳机床	VMC 850E	X/Y/Z:850×510×540 (0.02)	3
4	车铣中心	山崎马扎克	LGMazak QTN	直径 Ø380×1033 (0.01)	1
5	车削中心	山崎马扎克	LGMazak Nexus	直径 Ø360×1063 (0.01)	1
6	车削中心	山崎马扎克	LGMazak Nexus	直径 Ø280×300 (0.01)	2
7	线切割	沙迪克	AQ550Ls	X/Y/Z:550×350×320 (0.003)	1
8	线切割	阿奇夏米尔	CA30	X/Y/Z:600×400×350 (0.002)	1
9	氢气炉	北方华创	MHF5060	Φ500×600 (1100℃、±5℃)	1
10	氢气炉	北方华创	MHF3040	Φ300×400 (1100℃、±5℃)	1
11	三坐标	海克斯康	Classical	X/Y/Z:900×1200×800 (0.0026)	1
12	检漏仪	INFICON	UL1000 Fab	最小检漏漏率: 5×10 ⁻¹² mbar•L/s	1
13	真空炉	兰州真空	ZRT-3580-14W5	Φ1150×1650 (1300℃、±5℃)	1
14	电子束焊机	泰克米特	LARA52	X/Y/Z: 3300×1000×1300	1
15	电子束焊机	群达	THDW-9	X/Y/Z: 1050×500×700	1
16	四柱压力机	山东滕州	YQ32-200T	200T	1
17	网络分析仪	罗德施瓦茨	ZNB8	Max. 8.5GHz	1



1. Brief Introduction

■ EBW machines



EBW machine (3 sets)



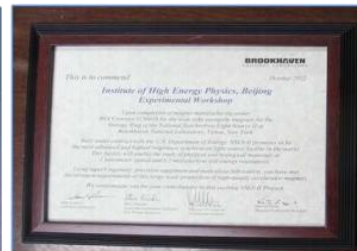
Laser Welding machine

1. Brief Introduction

■ Qualifications and Honors:

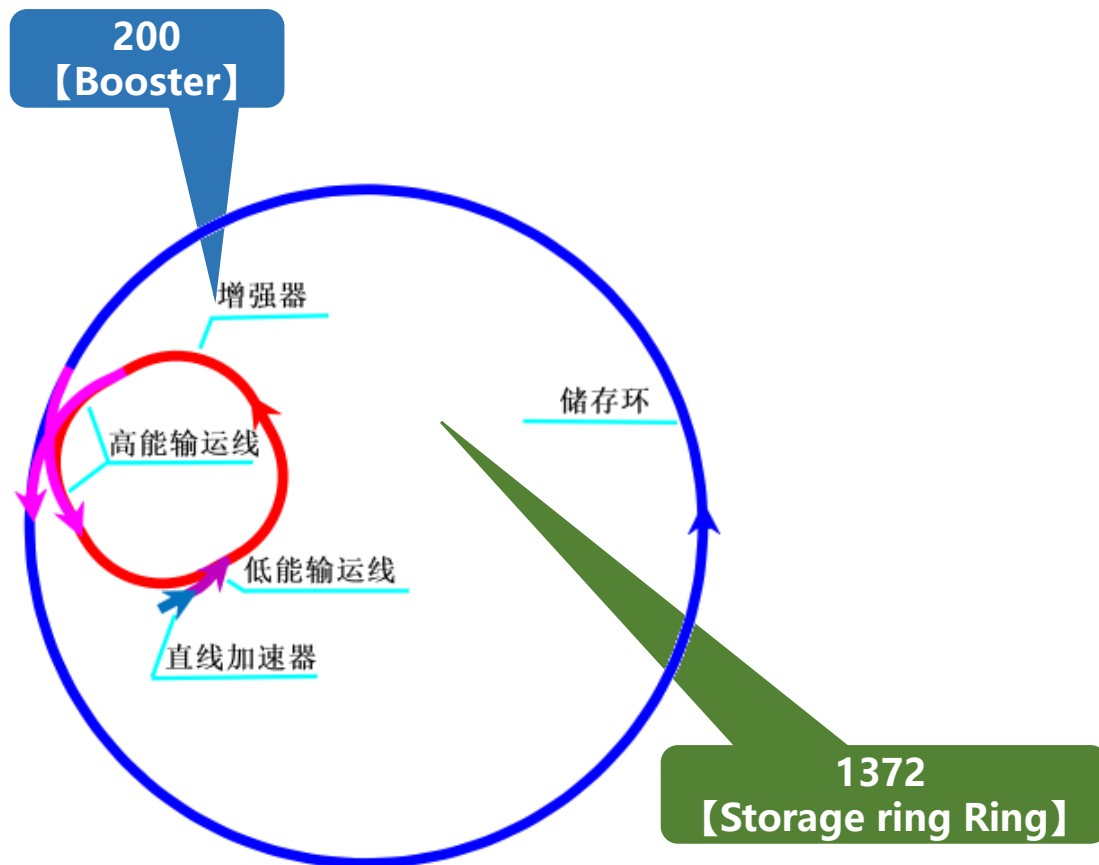


- ◆ 北京正负电子对撞机“重大技术装备”
- ◆ 北京正负电子对撞机改造工程（BECPII）建设中做出重大贡献；
- ◆ 中国散裂中子源工程“重大贡献参建单位”；
- ◆ 美国布鲁克海文实验室（BNL）NSLSII 磁铁贡献奖；
- ◆ 硬X射线自由电子激光装置”项目优秀设备研制供应商”



2. Magnets (HEPS)

2.1 Magnet List (1572 Sets in Total)



Booster Magnets		
Description	Qty. (set)	Period
Dipole	130	2019.12~2021.12
Sextupole	70	2019.12~2021.12

Storage Ring Magnets		
Description	Qty. (set)	Period
Sextupole	294	2020.05~2022.05
LG Dipole	98	2020.12~2023.06
Quadrupole	686	2020.12~2023.12
B&D magnet	294	2020.12~2023.12

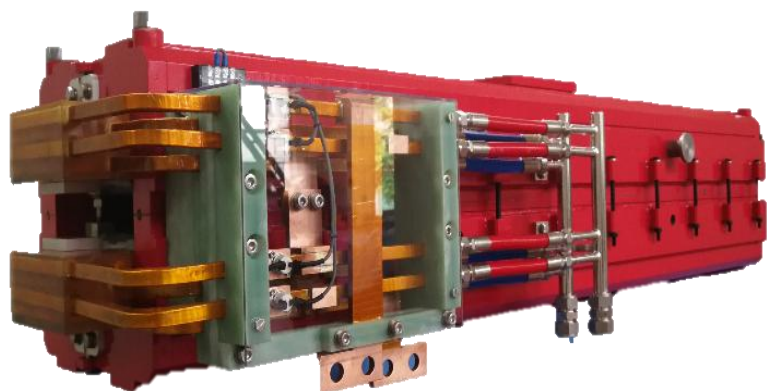
2. Magnets (HEPS)

2.2 Booster Magnets



2. Magnets (HEPS)

2.2.1 Booster Magnets (Dipole)



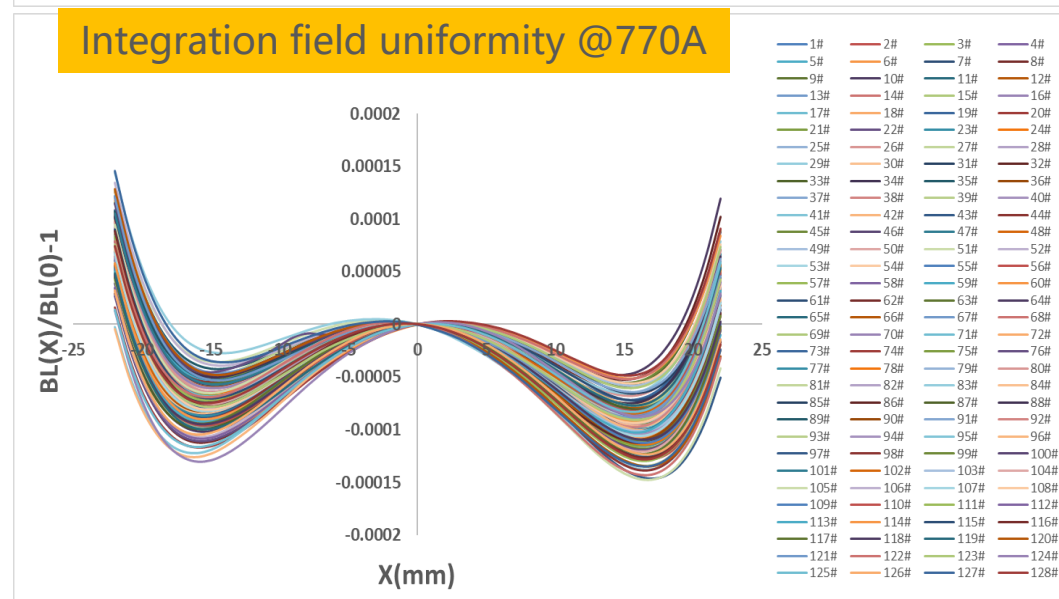
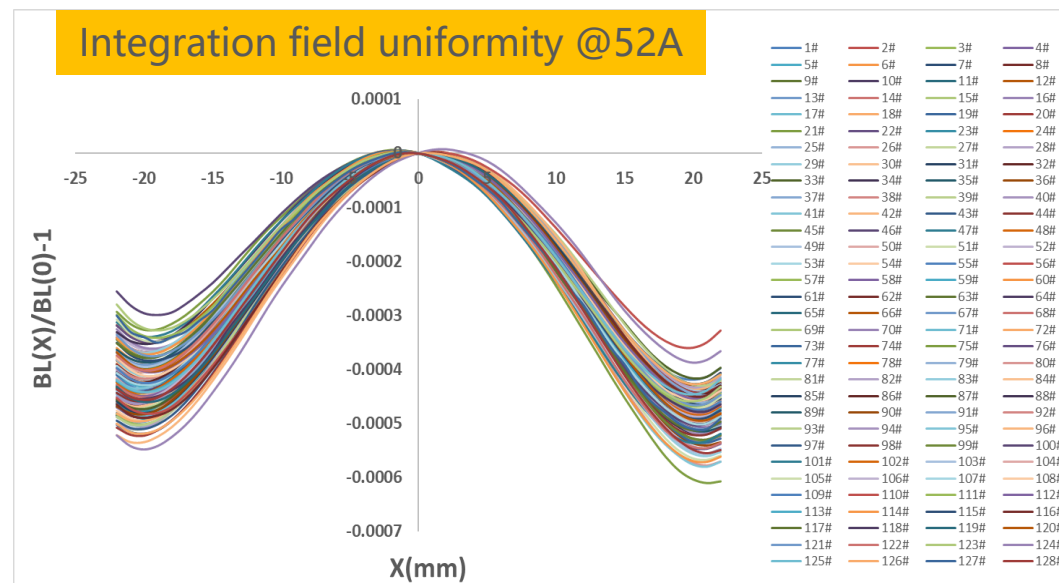
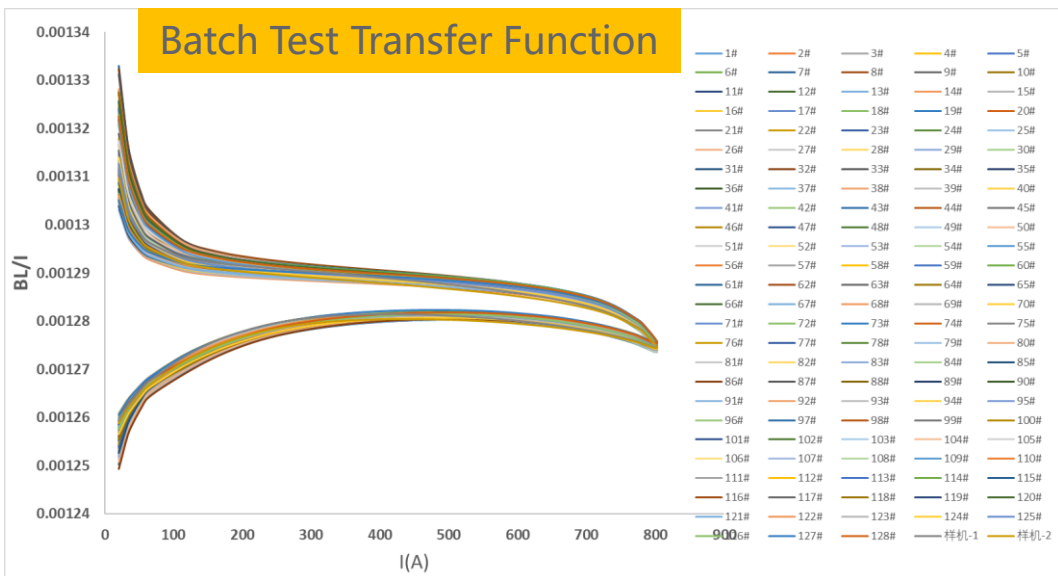
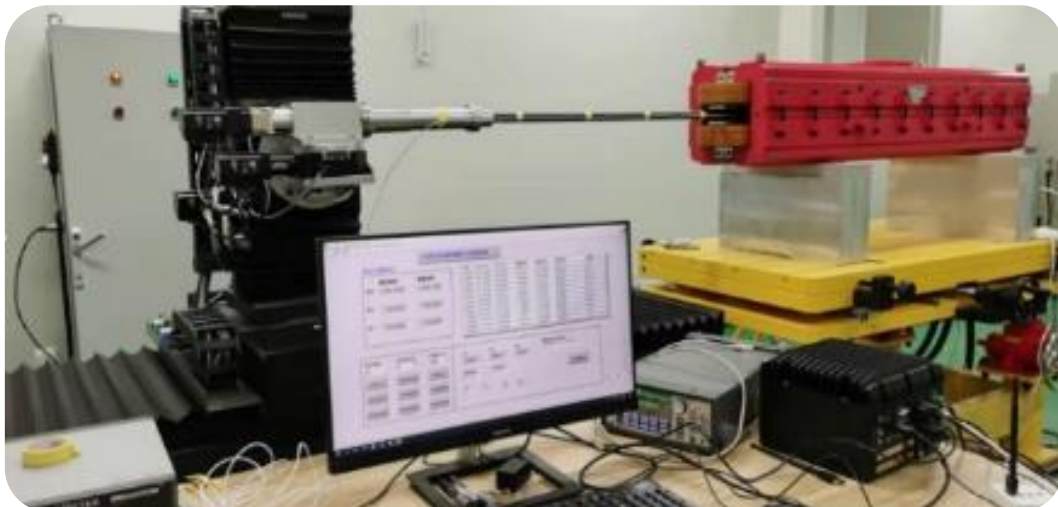
Core:

- Lamination type
- Glued and Welded

Parameters	Value	Unit
QTY.	130	set
L_{eff}	1.450	m
Max. Field(@6GeV)	0.68	T
Min. Field(@500MeV)	0.05	T
Bending Radius	29.540	m
Gap	34.00	mm
Good Field Area (H×V)	30×20	mm
Uniformity(@0.5GeV, 6GeV)	$1 \times 10^{-3}, 5 \times 10^{-4}$	-
Integral Gradient Discreteness	0.1%	-

2. Magnets (HEPS)

2.2.1 Booster Magnets (Dipole)

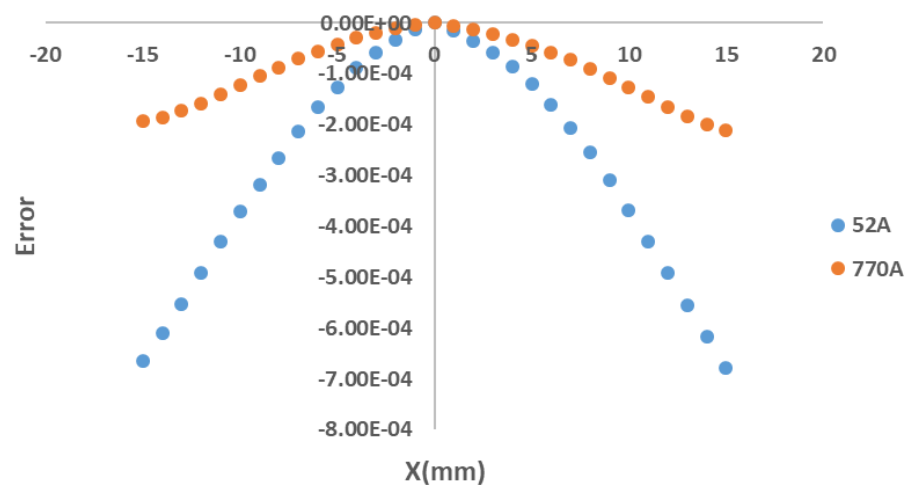


2. Magnets (HEPS)

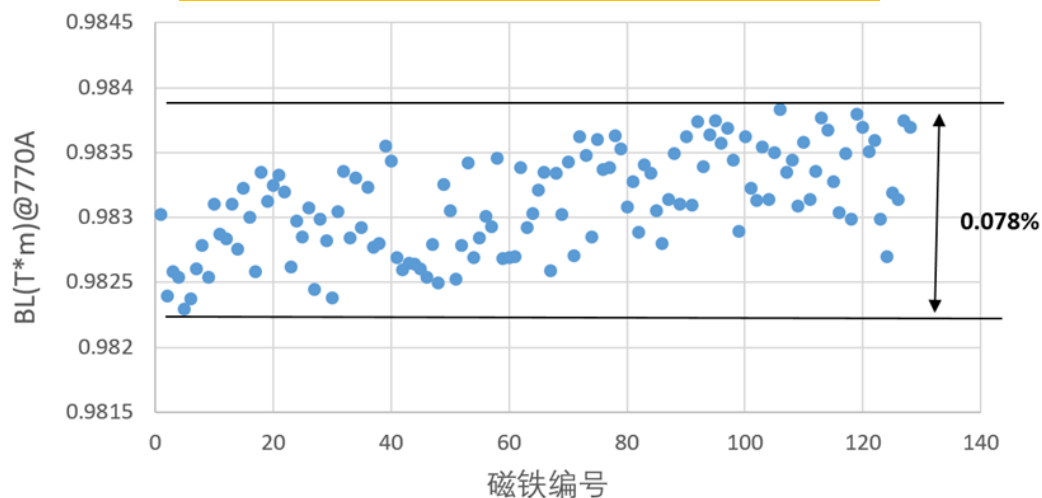
2.2.1 Booster Magnets (Dipole)



Field Distribution Error

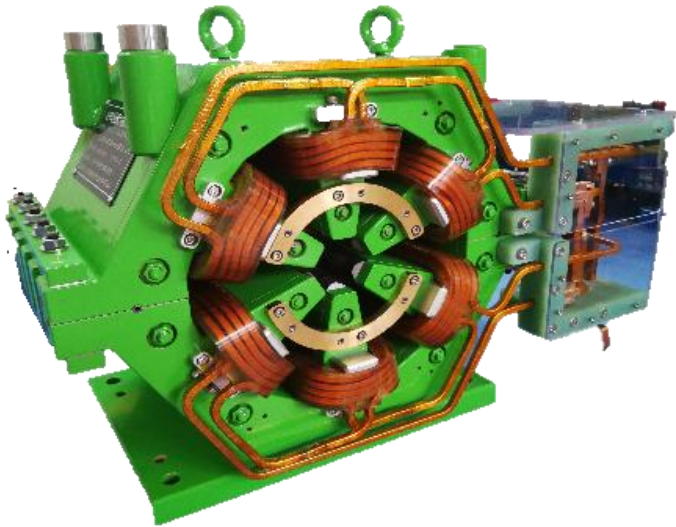


Batch Test Integral Field Discreteness



2. Magnets (HEPS)

2.2.2 Booster Magnets (Sextupole)



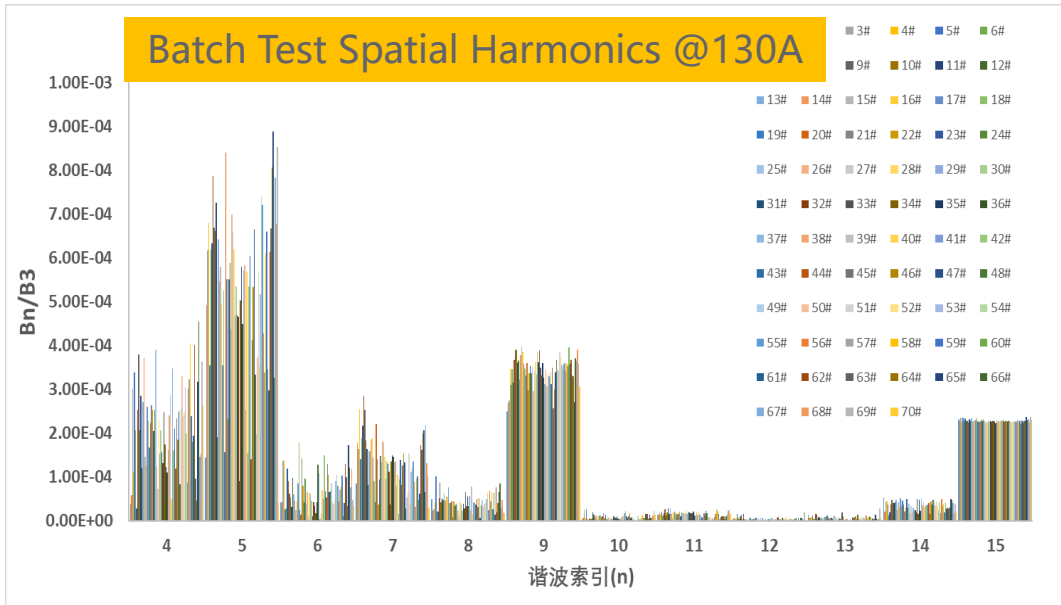
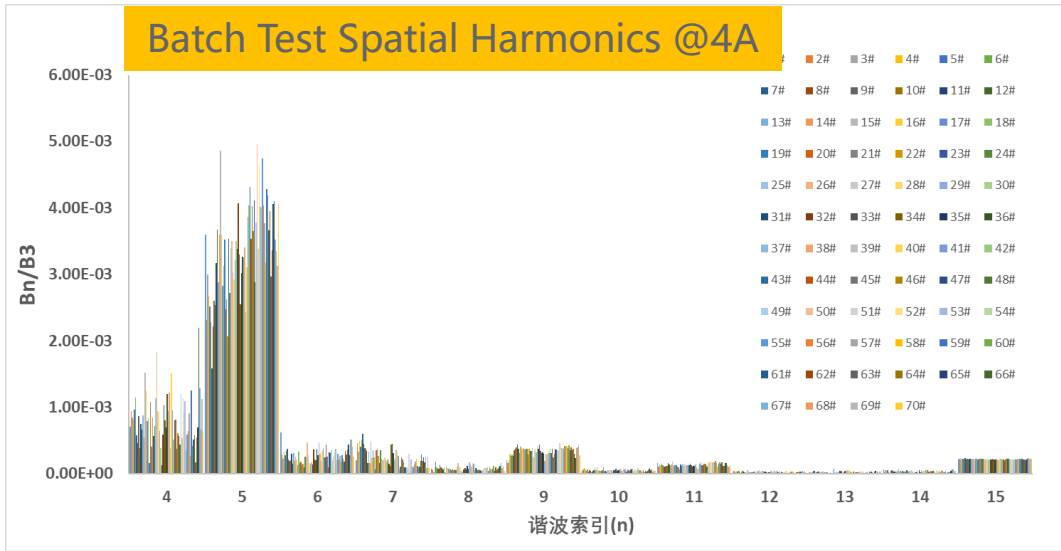
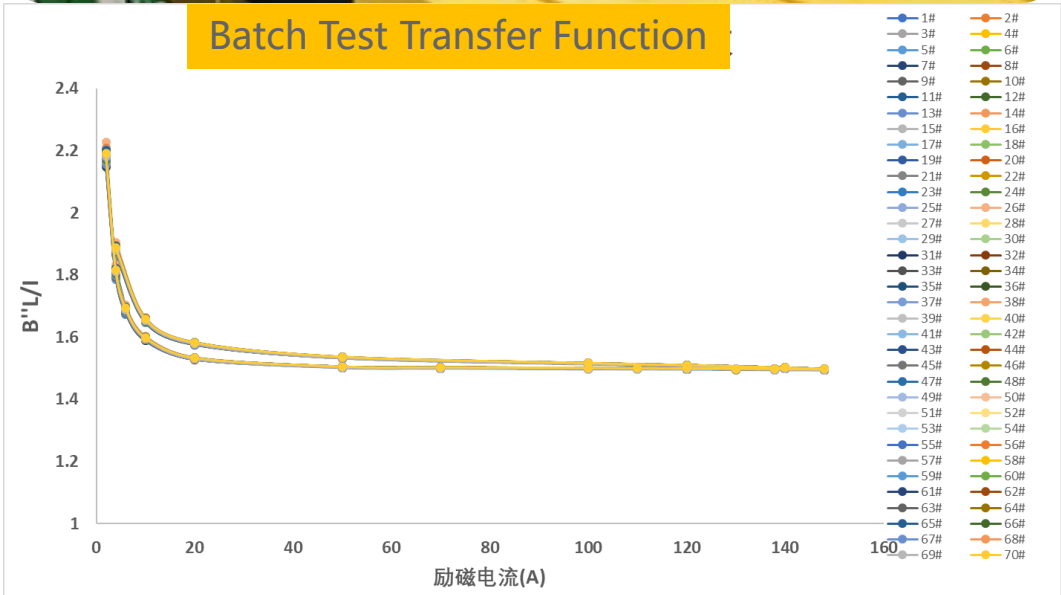
Core:

- Lamination type
- Glued

Parameters	Value	Unit
QTY.	70	set
Leff	0.2	m
Max. Field Gradient	1000	T/m ²
Min. Field Gradient	30	T/m ²
Good Field Radius	16	mm
Aperture	Φ40	mm
Harmonic Error(@0.5GeV, 6GeV)	$5 \times 10^{-3}, 1 \times 10^{-3}$	-
Integral Gradient Discreteness	0.2%	-

2. Magnets (HEPS)

2.2.2 Booster Magnets (Sextupole)

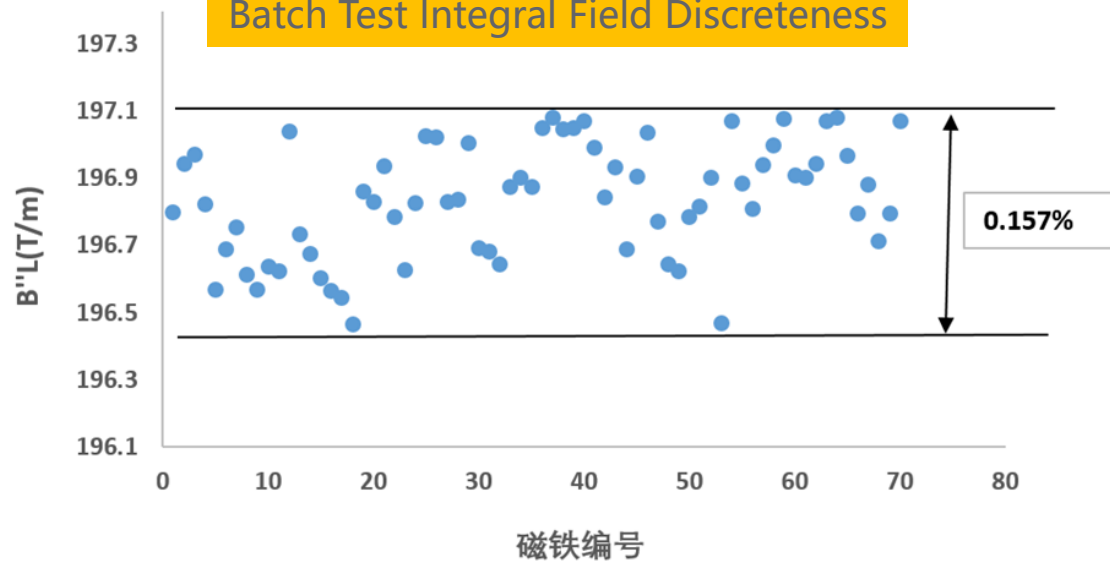


2. Magnets (HEPS)

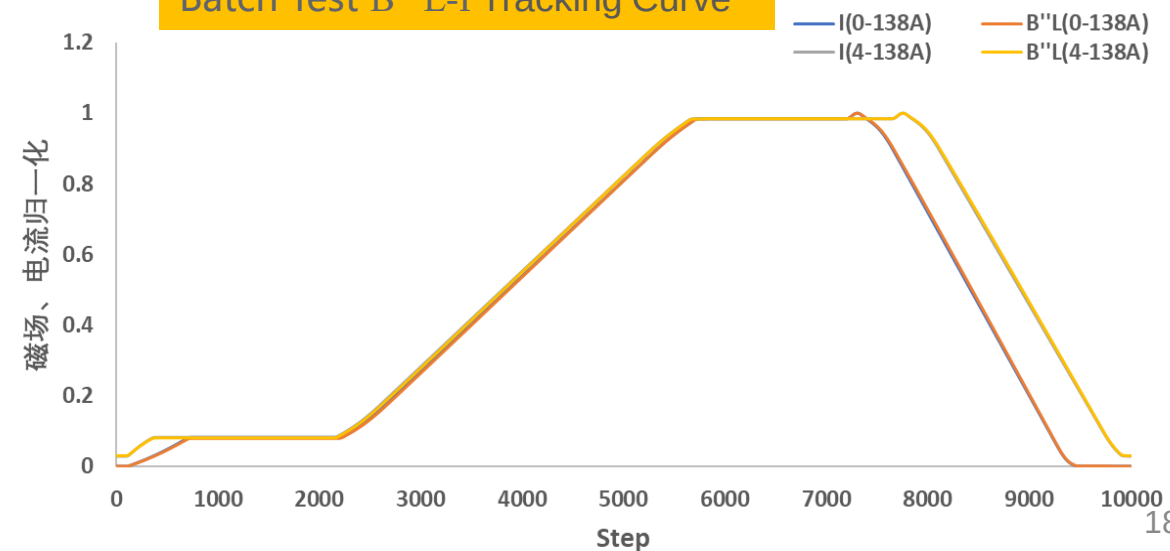
2.2.2 Booster Magnets (Sextupole)



Batch Test Integral Field Discreteness

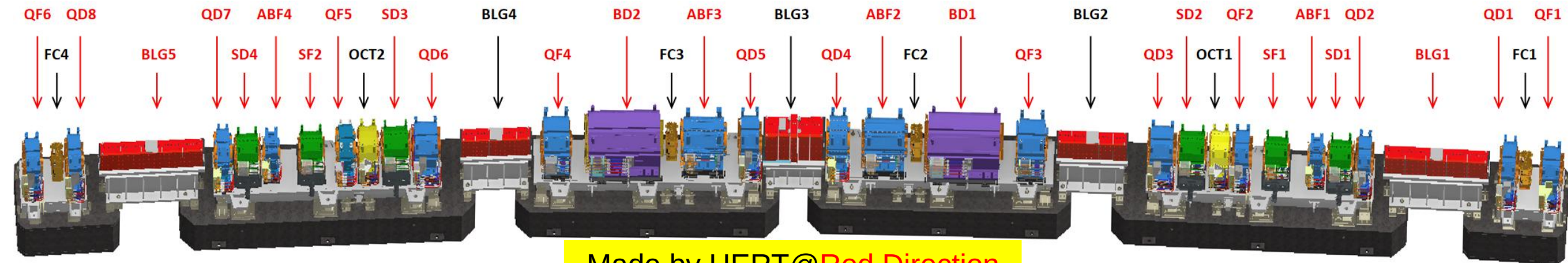


Batch Test B'' L-I Tracking Curve



2. Magnets (HEPS)

2.3 Storage Ring Magnets

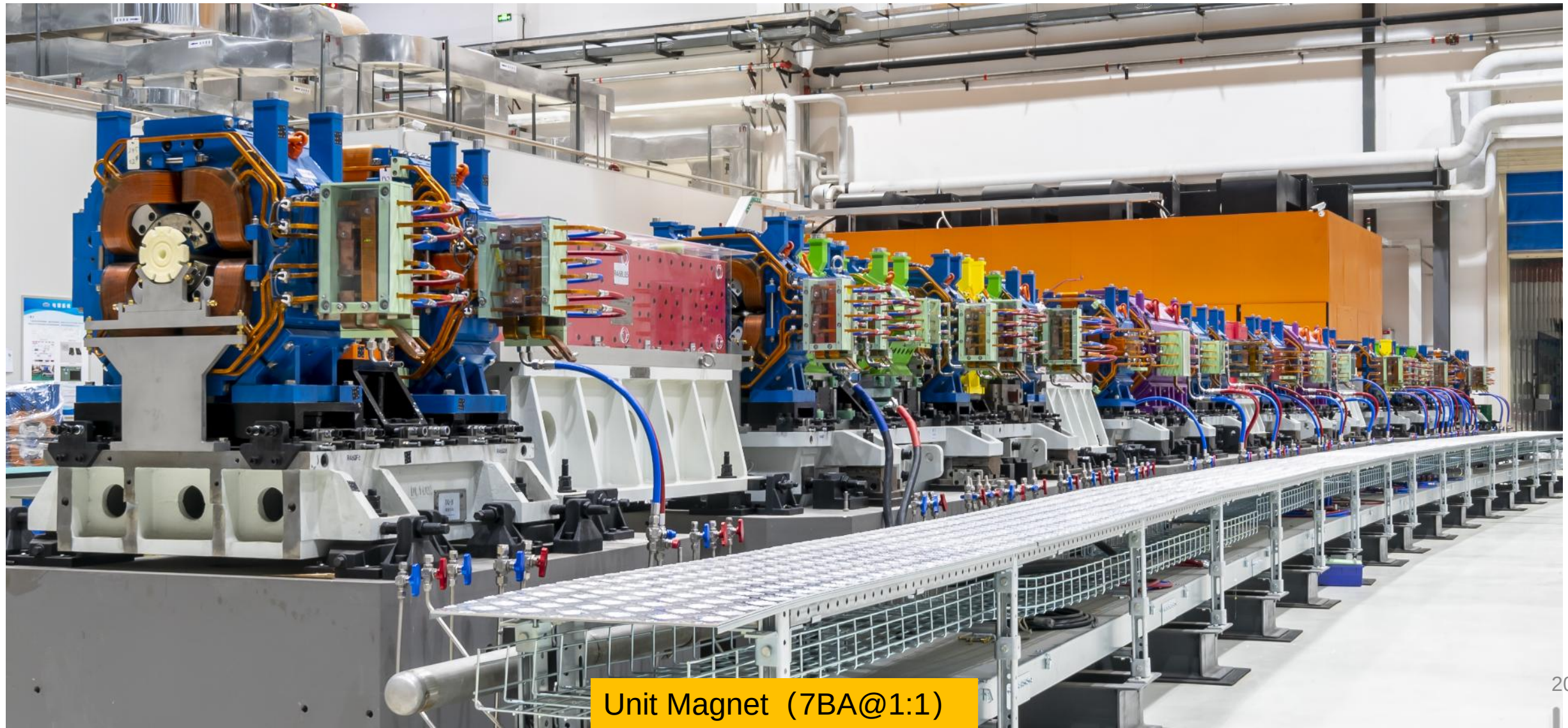


Made by HERT@Red Direction

Unit Magnet (7BA@Model and position indication)

2. Magnets (HEPS)

2.3 Storage Ring Magnets



Unit Magnet (7BA@1:1)

2. Magnets (HEPS)

2.3.1 Storage Ring Magnets (Dipoles)



Permanent Magnet:

■ Core (DT4 Steel)

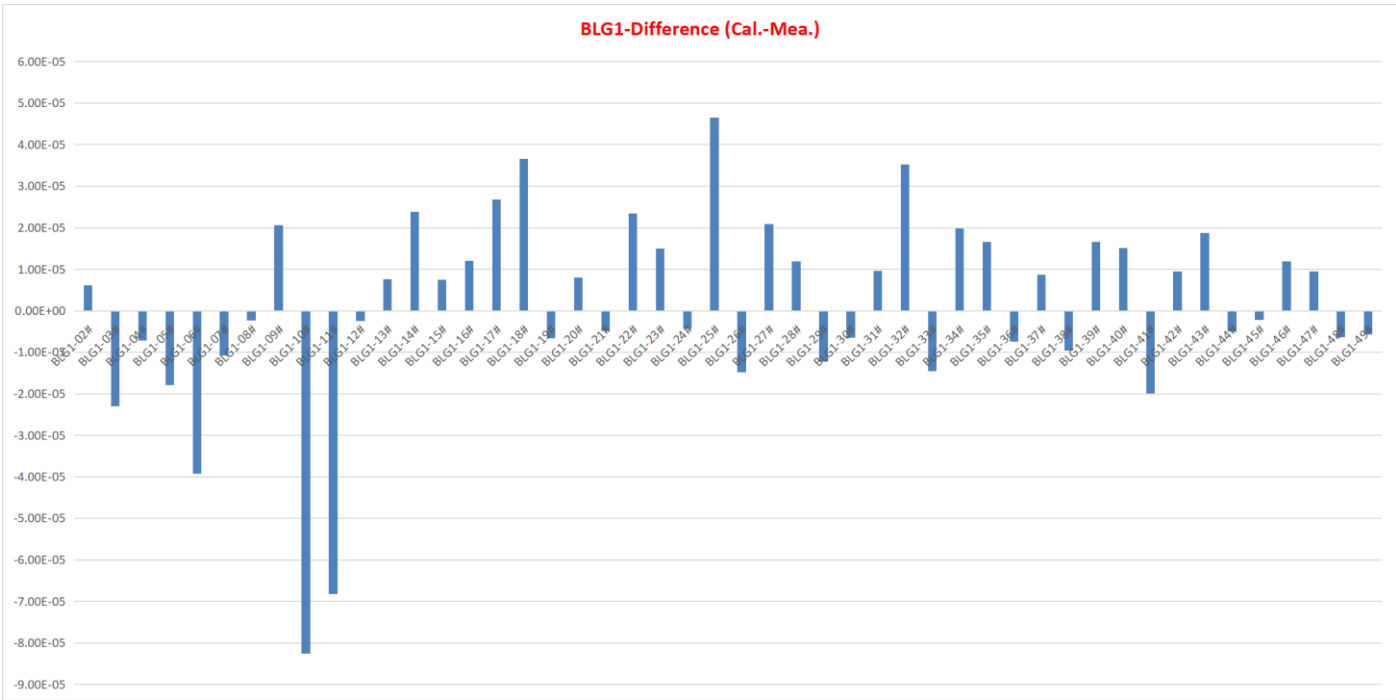
TYPE	BLG1 (Type I)	BLG5 (Type II)
Qty (set)	48+1	48+1
Leff (m)	1.499	1.499
File (Gauss) (5 steps)	4838.4/3357.3/2863.6/ 2073.6/1283.7	1283.7/2073.6/2863.6/ 3357.3/4838.4
Integral Field (Gauss·m)	4322.0	4322.0
Integral Field Discreetness	1×10^{-4}	1×10^{-4}
Good Field Area (H×V) (mm)	$[-11, 11] \times [-8, 8]$	$[-11, 11] \times [-8, 8]$
Uniformity	4×10^{-4}	4×10^{-4}

2. Magnets (HEPS)

2.3.1 Storage Ring Magnets (Dipoles)



Measurement Results(BLG1,49sets)



2. Magnets (HEPS)

2.3.2 Storage Ring Magnets (Quadrupole type I, 340sets)



Core:

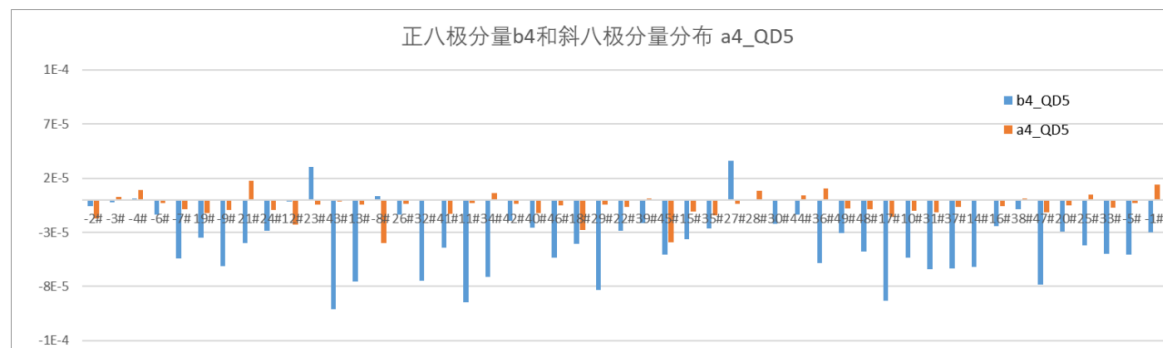
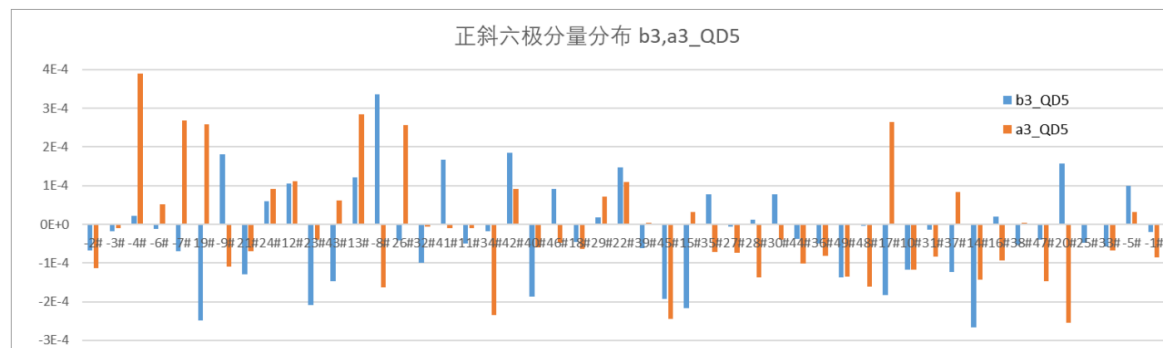
- Lamination type
- Welded

Description	QF1/6-245	QF1/6-201	QD2	QF2	QD3/6	QD5
QTY.(Set)	47+1	47+1	47+1	48+1	96+2	48+1
Core Length (mm)	245	201	180	201	327	260
Leff (mm)	255	211	190	211	337	270
Field Gradient (T/m)	78.2	77.5	73.7	77.2	78.7	74.2
Good Field Radius (mm)	5	5	5	5	5	5
Aperature (mm)	26	26	26	26	26	26
Harmonic Error	$B_3/B_2 \leq 4 \times 10^{-4}$, $B_4/B_2 \leq 4 \times 10^{-4}$, $B_5/B_2 \leq 2 \times 10^{-4}$, $B_n/B_2 \leq 1 \times 10^{-4}$ for $n > 5$					
Integral Gradient Discreetness	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%
Bonding Coil	None	None	None	None	None	None

2. Magnets (HEPS)

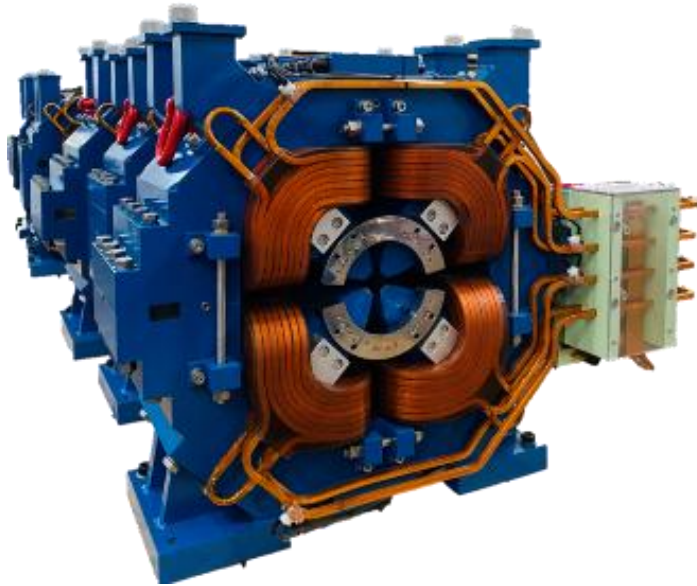
2.3.2 Storage Ring Magnets (Quadrupole type I, 340sets)

Measurement Results (QD5, 49 sets)



2. Magnets (HEPS)

2.3.3 Storage Ring Magnets (Quadrupole type II, 148sets)



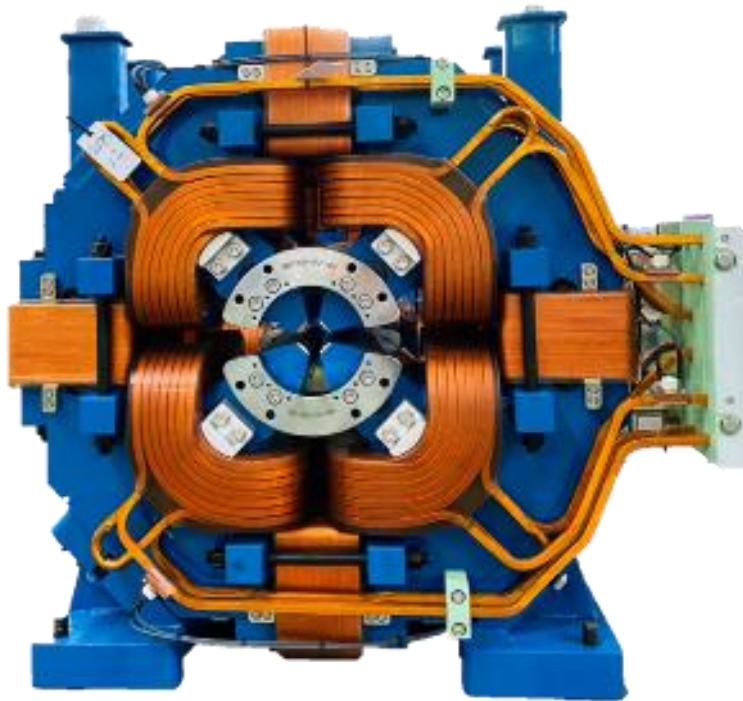
Core:

■ DT4 Steel

Description	QD4	QF5	QD7
QTY.(Set)	48+1	48+1	49+1
Core Length (mm)	260	201	180
Leff (mm)	270	211	190
Field Gradient (T/m)	74.2	77.2	73.7
Good Field Radius (mm)	5	5	5
Aperature (mm)	26	26	26
Harmonic Error	$B_3/B_2 \leq 4 \times 10^{-4}$, $B_4/B_2 \leq 4 \times 10^{-4}$, $B_5/B_2 \leq 2 \times 10^{-4}$, $B_n/B_2 \leq 1 \times 10^{-4}$ for $n > 5$		
Integral Gradient Discreteness	0.2%	0.2%	0.2%
Bonding Coil	None	None	None

2. Magnets (HEPS)

2.3.4 Storage Ring Magnets (Quadrupole ,with bonding coil, 194sets)



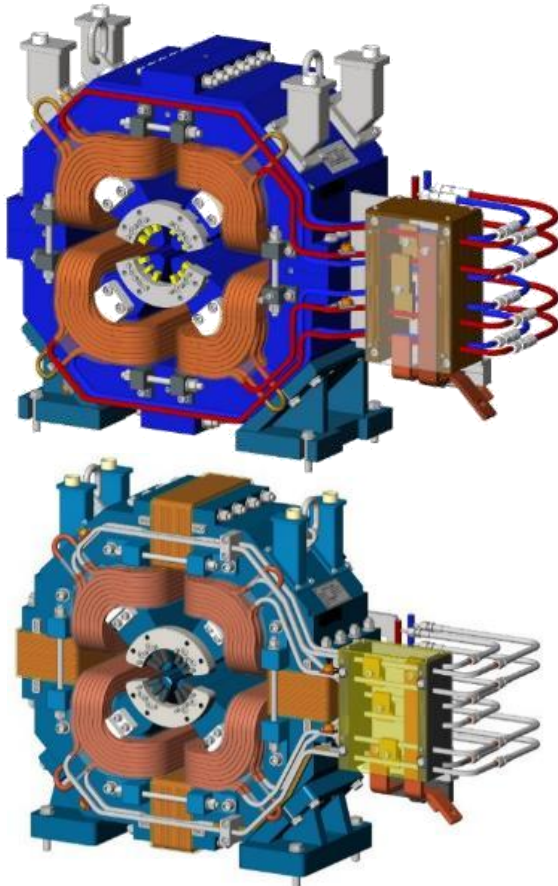
Core:

- Lamination type
- Welded

Description	QD1/8-192	QD1/8-180	QF3/4
QTY.(Set)	47+1	47+1	96+2
Core Length (mm)	192	180	374
Leff (mm)	202	190	384
Field Gradient (T/m)	77.4	68.7	79.6
Good Field Radius (mm)	5	5	5
Aperature (mm)	26	26	26
Harmonic Error	$B_3/B_2 \leq 4 \times 10^{-4}$, $B_4/B_2 \leq 4 \times 10^{-4}$, $B_5/B_2 \leq 2 \times 10^{-4}$, $B_n/B_2 \leq 1 \times 10^{-4}$ for $n > 5$		
Integral Gradient Discreteness	0.2%	0.2%	0.2%
Bonding Coil	Yes	Yes	Yes

2. Magnets (HEPS)

2.3.4 Storage Ring Magnets (Quadrupole ,Special, 4sets)



Core:

■ DT4 Steel

Description	R02QF6	R48QF1	R02QD8	R48QD1
QTY.(Set)	1	1	1	1
Core Length (mm)	245	201	192	180
Leff (mm)	255	211	202	190
Field Gradient (T/m)	78.2	77.5	77.4	68.7
Good Field Radius (mm)	5	5	5	5
Aperature (mm)	26	26	26	26
Harmonic Error	$B_3/B_2 \leq 4 \times 10^{-4}$, $B_4/B_2 \leq 4 \times 10^{-4}$, $B_5/B_2 \leq 2 \times 10^{-4}$, $B_n/B_2 \leq 1 \times 10^{-4}$ for $n > 5$			
Integral Gradient Discreteness	0.2%	0.2%	0.2%	0.2%
Bonding Coil	None	None	Yes	Yes

2. Magnets (HEPS)

2.3.6 Storage Ring Magnets (B&D, 294sets)



Core:

- Lamination type
- Welded



Core:

- DT4 Steel



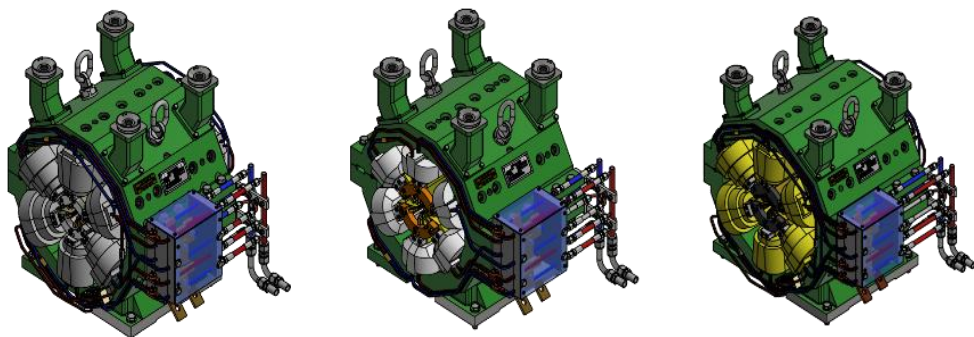
Core:

- Lamination type
- Welded

Description	BD12	ABF1/4	ABF2/3
QTY.(Set)	96+2	96+2	96+2
Core Length (mm)	1040	180	590
Leff (mm)	197.2	179.9	609.9
Field Gradient (T/m)	34.54	53.43	66.43
Good Field Radius (mm)	5	5	5
Aperature (mm)	45	30	30
Harmonic Error	$B_3/B_2 \leq 6 \times 10^{-4}$, $B_4/B_2 \leq 6 \times 10^{-4}$, $B_5/B_2 \leq 3 \times 10^{-4}$, $B_n/B_2 \leq 1.5 \times 10^{-4}$ for $n > 5$		
Integral Gradient Discreteness	0.2%	0.2%	0.2%
Bonding Coil	None	None	None

2. Magnets (HEPS)

2.3.7 Sextupole (3 types, 294 sets)



Core:

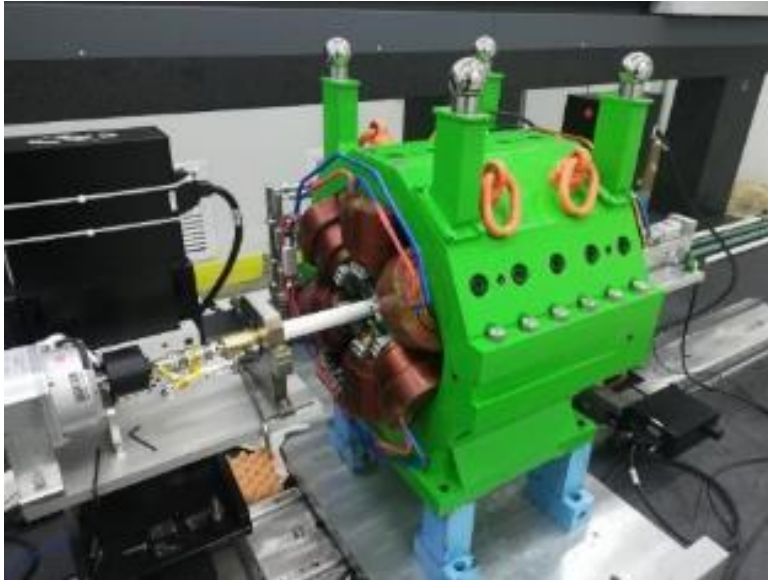
■ Core (DT4 Steel)

Description	SD1&4	SD2&3	SF1&2
QTY.(Set)	96+2	96+2	96+2
Core Length (mm)	304	350	318
Leff (mm)	314	358	326
Field Gradient (T/m ²)	4588	7360	7494
Integral Gradient Discreteness	6×10^{-3}		
Integral Gradient Discreteness (Sorting)	3×10^{-3}		
Good Field Radius (mm)	5	5	5
Aperature (mm)	26	26	26
Harmonic Error	$B_4/B_3 \leq 5 \times 10^{-3}$, $B_5/B_3 \leq 2.5 \times 10^{-3}$, $B_n/B_3 \leq 1.25 \times 10^{-3}$ for $n > 5$		
Bonding Coil	Yes	Yes	None

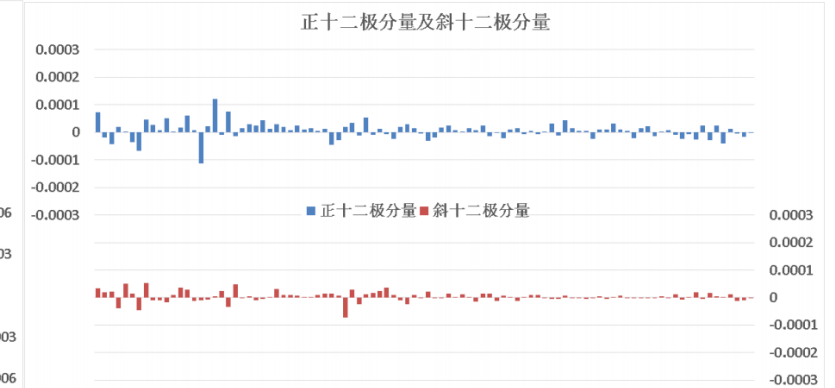
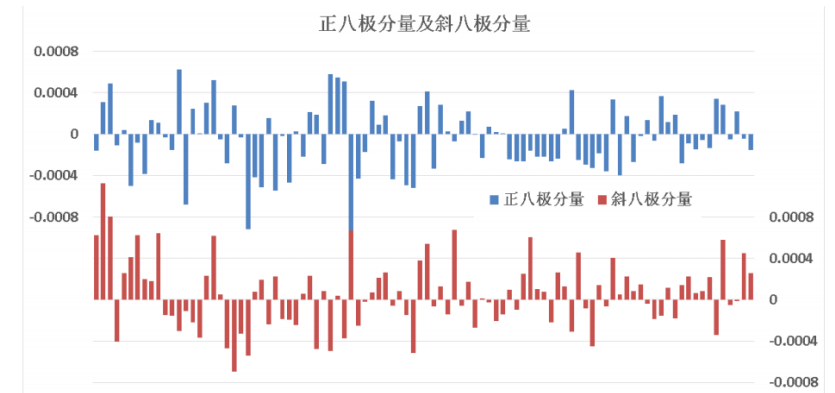
2. Magnets (HEPS)

2.3.7 Sextupole (3 types, 294 sets)

Measurement Results(SD23,98sets)



- 系统高阶场分量 b_9 基本为常数($1.6E-04$)。
- 由加工装配综合误差引起的八极、十极和十二极磁场如图 所示。



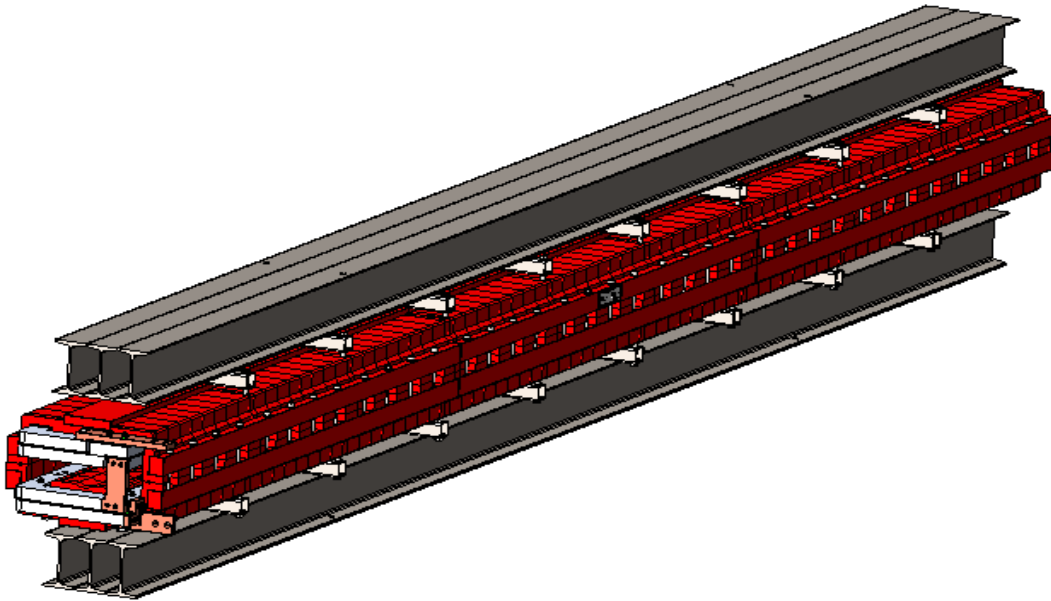
2. Magnets (HEPS)

HEPS Storage Ring



2. Magnets (CEPC)

2.4 CEPC Booster dipole-sextupole combined magnets



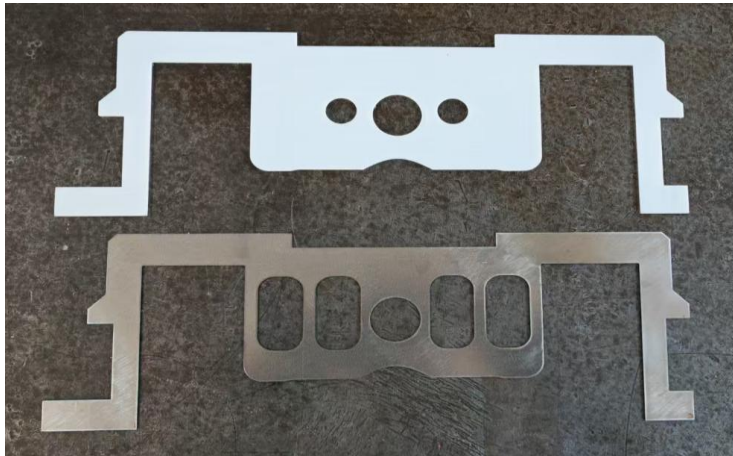
Core:

- Lamination type
- Welded

Parameters	Value	Unit
QTY.	1	set
Magnetic length	4700	mm
Core Length	4608	m
Dipole Field [Gs] @180 GeV	564	Gs
Dipole Field [Gs] @120 GeV	376	Gs
Dipole Field [Gs] @30 GeV	95	Gs
GFR	± 22.5	mm
Field errors	$\pm 1 \times 10^{-3}$	/
Gap	63	mm

2. Magnets (CEPC)

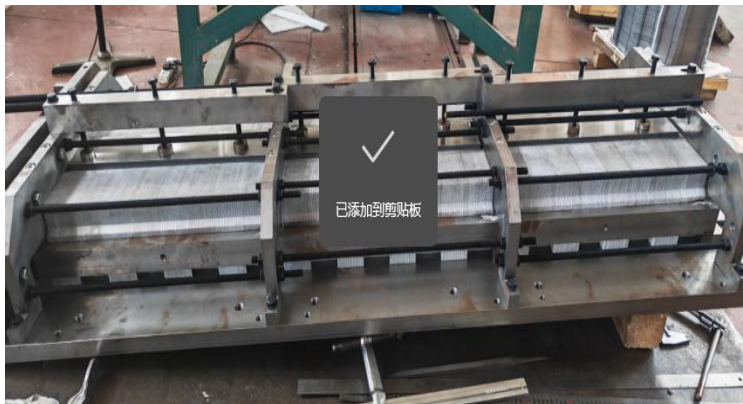
2.4 Dipole combined with Sextupole (Prototype)



Lamination type (steel+plastic)



Assembly

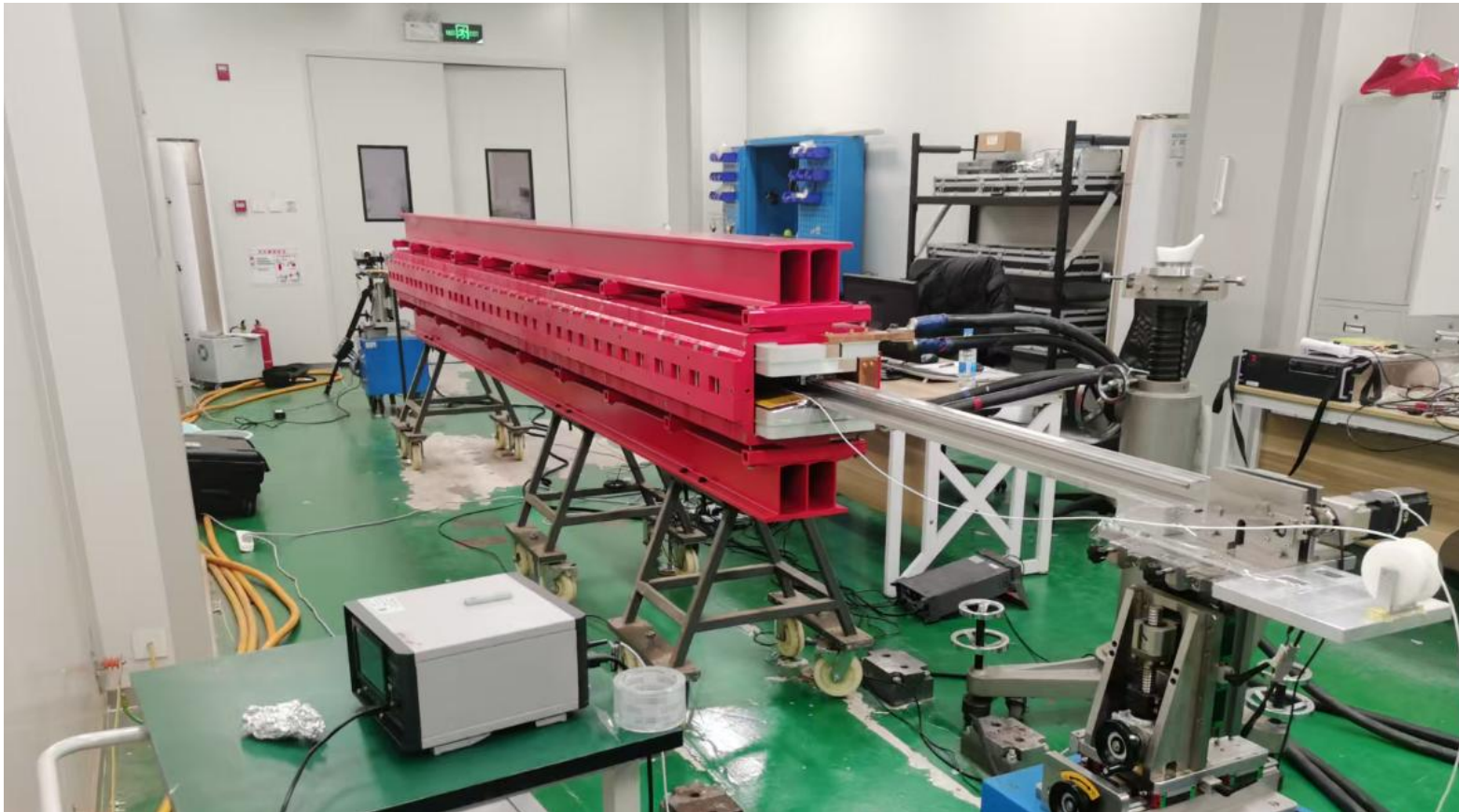


Stacking



2. Magnets (CEPC)

2.4 Dipole combined with Sextupole (Prototype)



Magnetic field test

2. Magnets (PWFA)

2.5 Dipole & Quadrupole

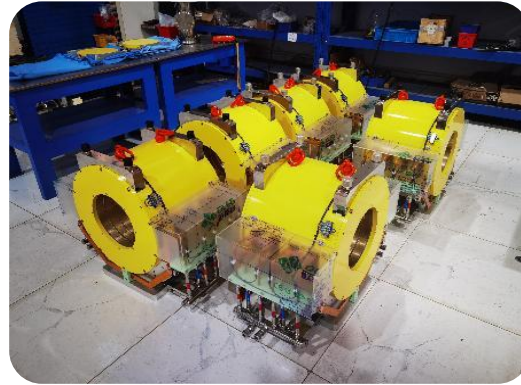


2. Magnets (HALF)

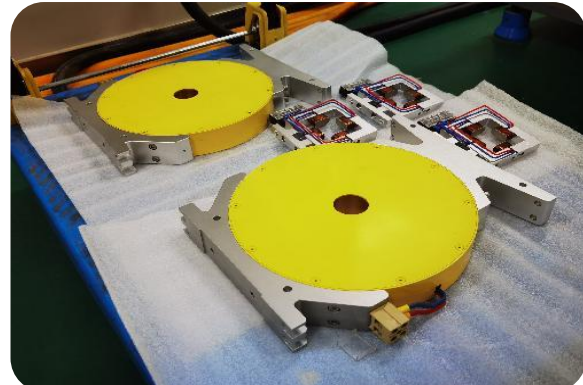
2.6 Injector (Solenoid and Corrector)



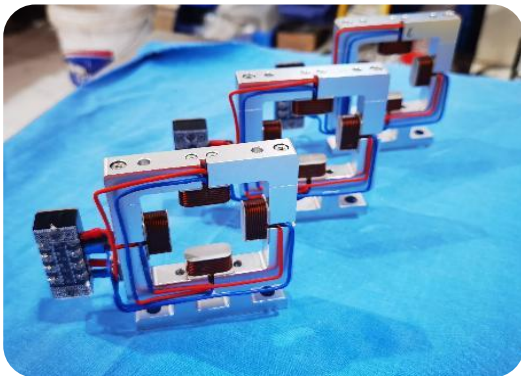
Middle (2sets)



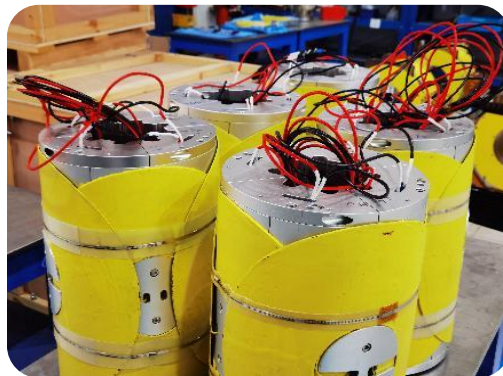
Long (2sets)



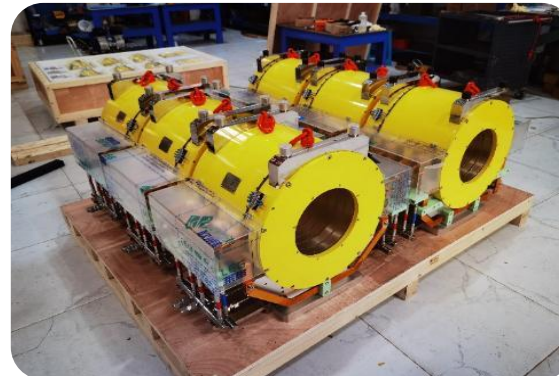
Short (2sets)



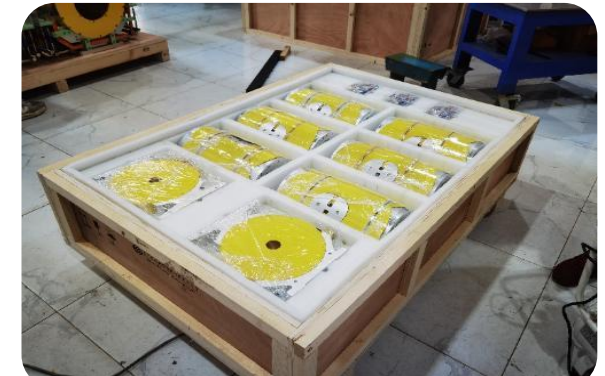
Corrector (3sets)



Corrector coils (6sets)

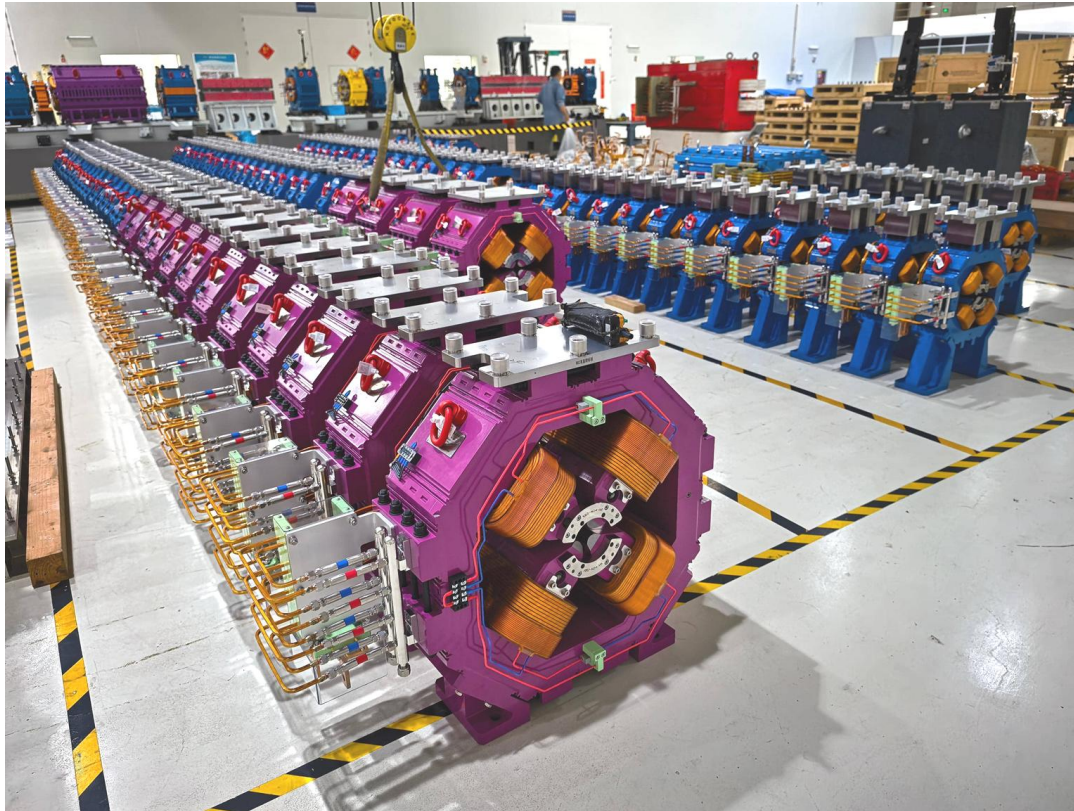


Packing



2. Magnets (HALF)

2.6 Storage Ring Magnets (**Quadrupole, Bias Quadrupole & Sextupole, 537 sets**)



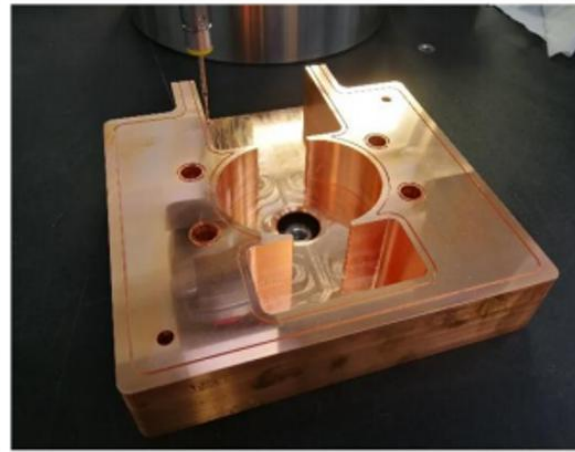
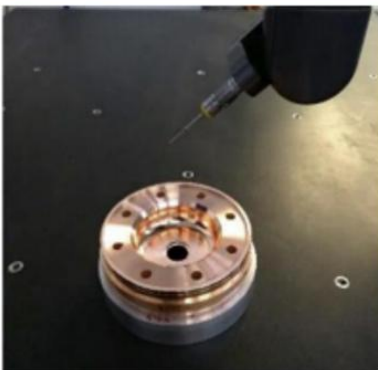
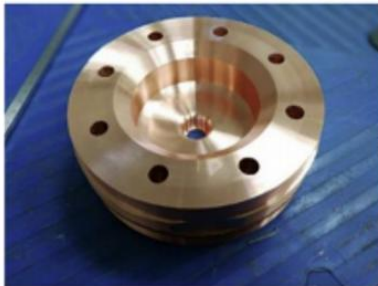
Quadrupole, Bias Quadrupole



Sextupole

3. Accelerating Structure and RT Cavities

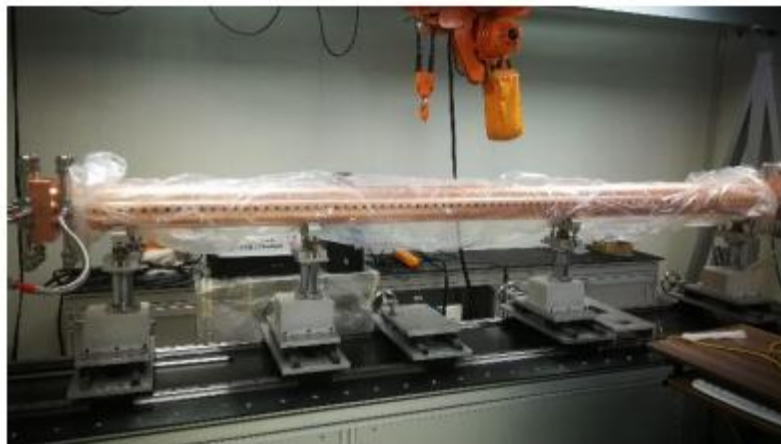
3.1 S Band Accelerating Structures (HEPS 9 sets)



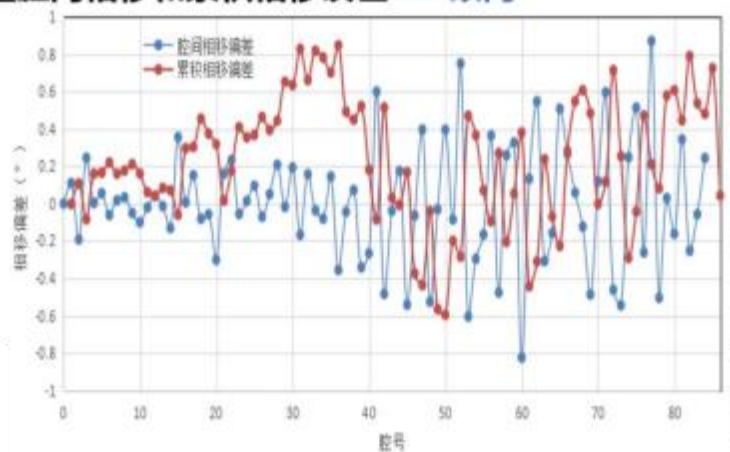
3. Accelerating Structure and RT Cavities

3.1 S Band Accelerating Structures (HEPS 9 sets)

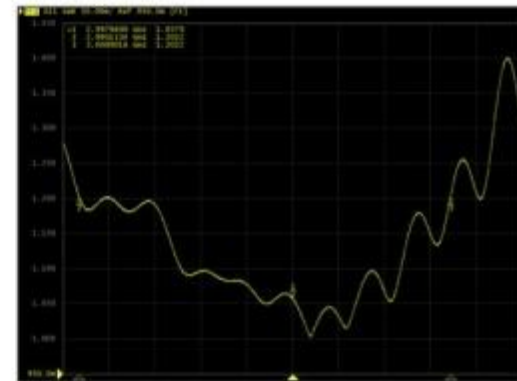
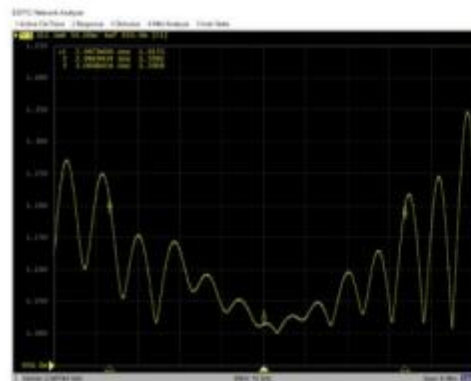
■ 将根据采购方的要求，协助进行加速管的测试与调谐



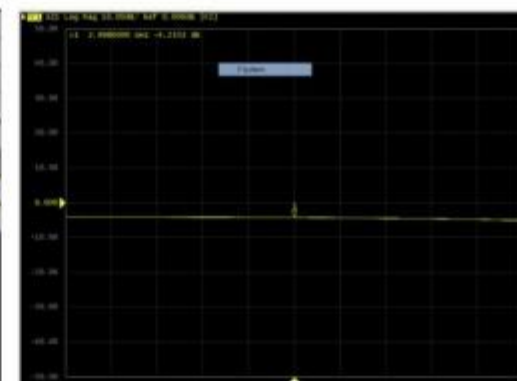
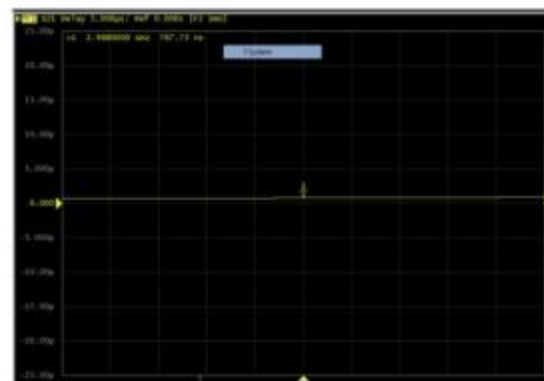
■ 调整腔间相移和累积相移误差 $\pm 2^\circ$ 以内



■ 完成输入/输出耦合器驻波比测试 (≤ 1.1)



■ 填充时间与衰减测试

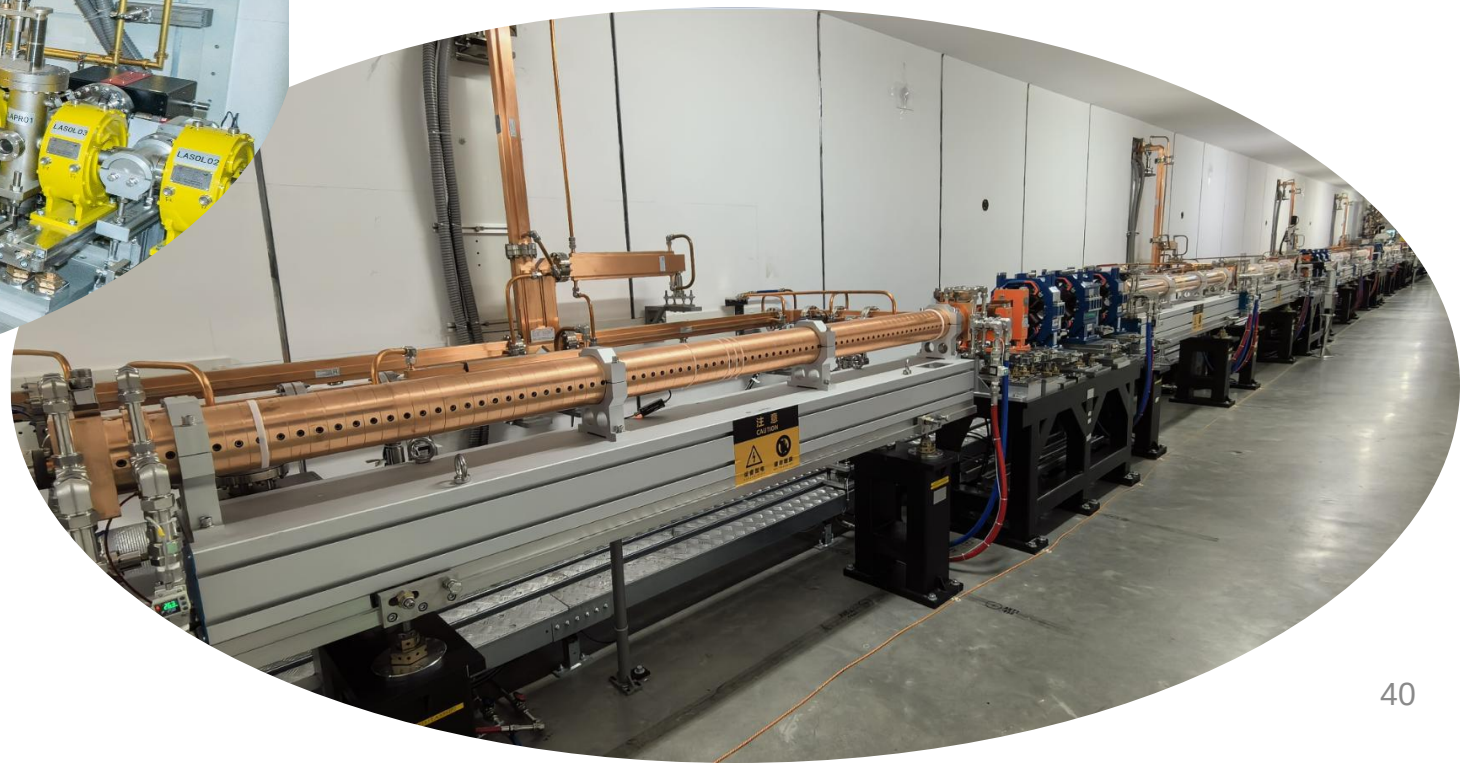


3. Accelerating Structure and RT Cavities

3.1 S Band Accelerating Structures (HEPS 9 sets)



HEPS Linac



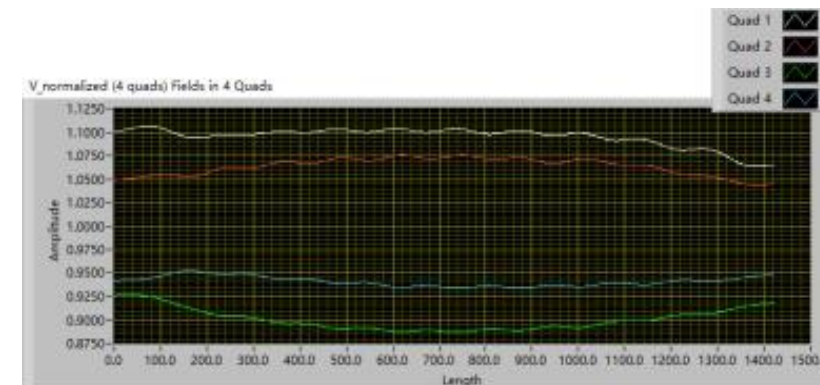
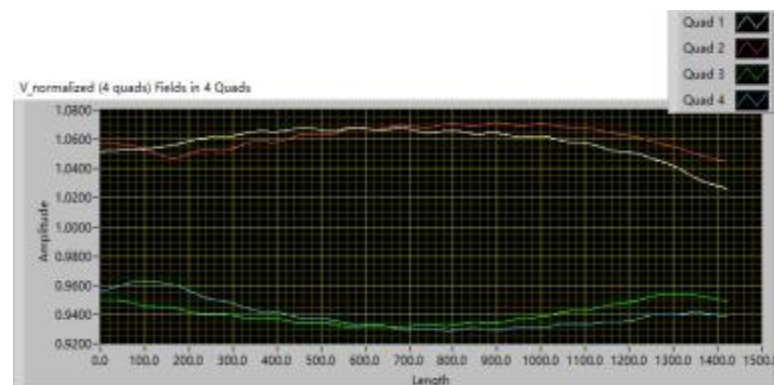
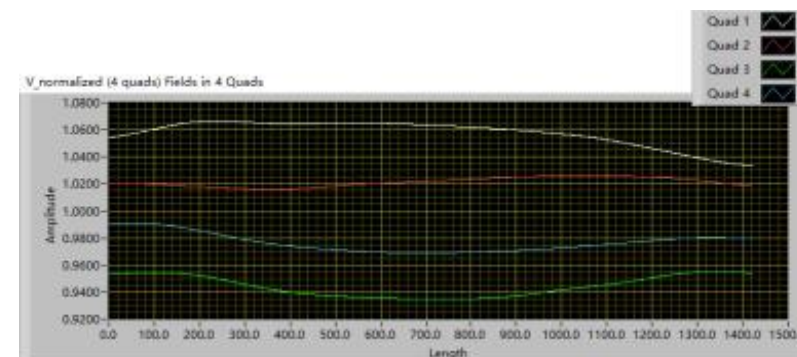
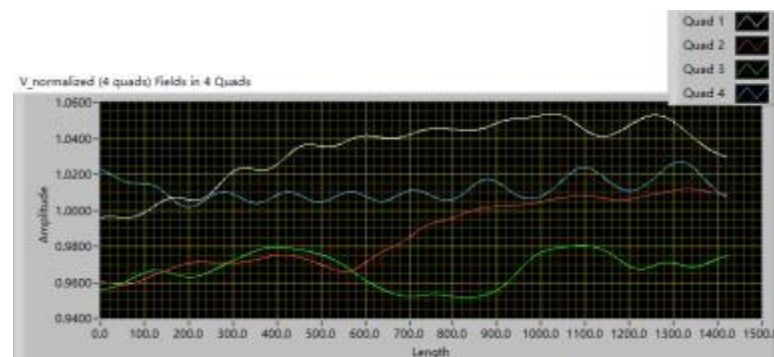
3. Accelerating Structure and RT Cavities

3.2 S Band Accelerating Structures (PWFA 2 sets)



3. Accelerating Structure and RT Cavities

3.2 RT Cavities (RFQ)



3. Accelerating Structure and RT Cavities

3.3 RT Cavities (DTL)



图5 漂移管 Z 向绝对值偏差



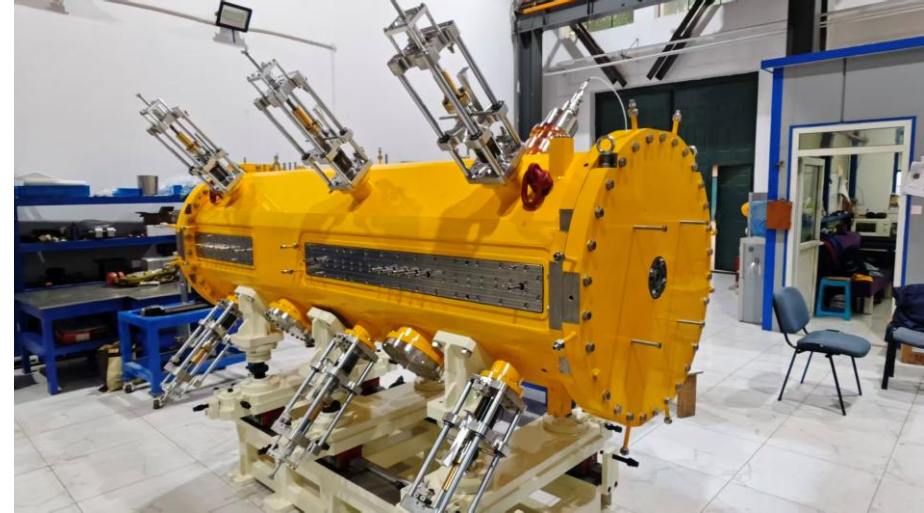
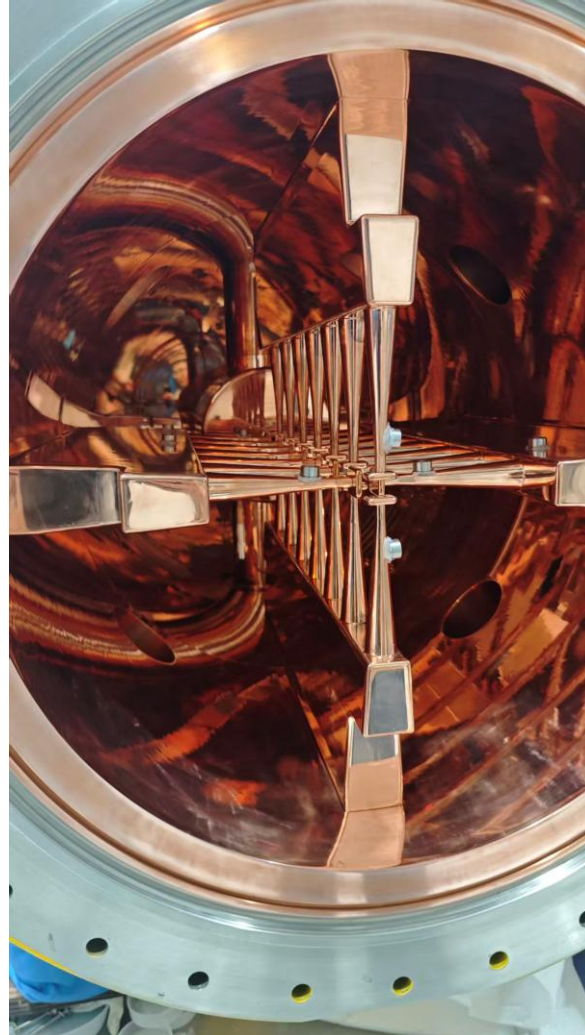
图3 漂移管 X 向同轴偏差



图4 漂移管 Y 向同轴偏差

3. Accelerating Structure and RT Cavities

3.4 RT Cavities (CH-DTL)



4. SRF Cavities Couplers and Cryomodules

2.1 Cavities (200 Pieces)

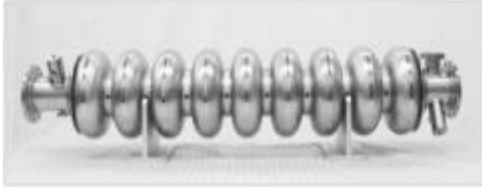
序号	科学装置	腔类型	频率 (MHz)	数量 (只)	测试梯度 (MV/m)	工作状态
1	HEPS-TF	QWR	166.7	2	19	垂测
2	HEPS	QWR	166.7	10	14	水平
3	CiADS	Spoke, $\beta=0.12$	325	4	11.5	带束运行
4	CiADS	Spoke, $\beta=0.21$	325	5	12	带束运行
5	CiADS	Spoke, $\beta=0.24$	325	1	11.2	垂测
6	CiADS	双Spoke, $\beta=0.51$	325	1	16	垂测
7	CSNSII	双Spoke, $\beta=0.51$	325	4	13	垂测
8	RISP	Spoke, $\beta=0.51$	325	7	12	垂测
9	HEPS	单CELL 椭球腔	500	4	16	垂测 (4K)
10	BIIU	单CELL 椭球腔	500	2	16	垂测 (4K)
11	HALF	单CELL 椭球腔	500	2	16	垂测 (4K)
12	CSNSII	6CELL 椭球腔	648	1	24	垂测
13	CEPC	2CELL 椭球腔	650	1	24	垂测
14	CEPC	5CELL 椭球腔	650	3	12	垂测 (4K)
15	PAPS	2CELL 椭球腔	650	3	36	垂测
16	CiADS	6CELL 椭球腔	650	1	24	垂测
17		5CELL 椭球腔	975	1	17	垂测
18	PAPS&SHINE	单CELL 椭球腔	1300	28	43	垂测
19	ILC R&D	9CELL 椭球腔	1300	1	24	垂测
20	PAPS	9CELL 椭球腔	1300	2	25	垂测
21	SHINE先导	9CELL 椭球腔	1300	8	25	水平
22	SHINE小批	9CELL 椭球腔	1300	8	25	垂测
23	SHINE批量1	9CELL 椭球腔	1300	72	25-30	垂测
24	SHINE批量2	9CELL 椭球腔	1300	12	/	待测试
25	ZJ Lab	9CELL 椭球腔	1300	9	25	垂测
25	DALS	9CELL 椭球腔	1300	8	23	水平
26	HALF	1CELL 椭球腔	1500	2	/	待测试

4. SRF Cavities Couplers and Cryomodules

4.2 Cavities-Pictures



Spoke 024
第一支超导腔
(325MHz)



9 Cell 超导腔
第一支椭圆腔
(1.3GHz)



2 Cell 超导腔
5 Cell 超导腔
(650MHz)



双Spoke腔
(325MHz)



Spoke 051
SSR2超导腔
(325MHz)



QWR Cavity
HEPS超导腔
(166.7MHz)



Spoke 012
ADS 注入器超导腔
小批量生产



Spoke 021
ADS 主加速器超导腔
小批量生产



HEPS-TF超导腔
第一支QWR超导腔
(166.7MHz)



高Q值1.3GHz 9 Cell
高Q值1.3GHz 单 Cell



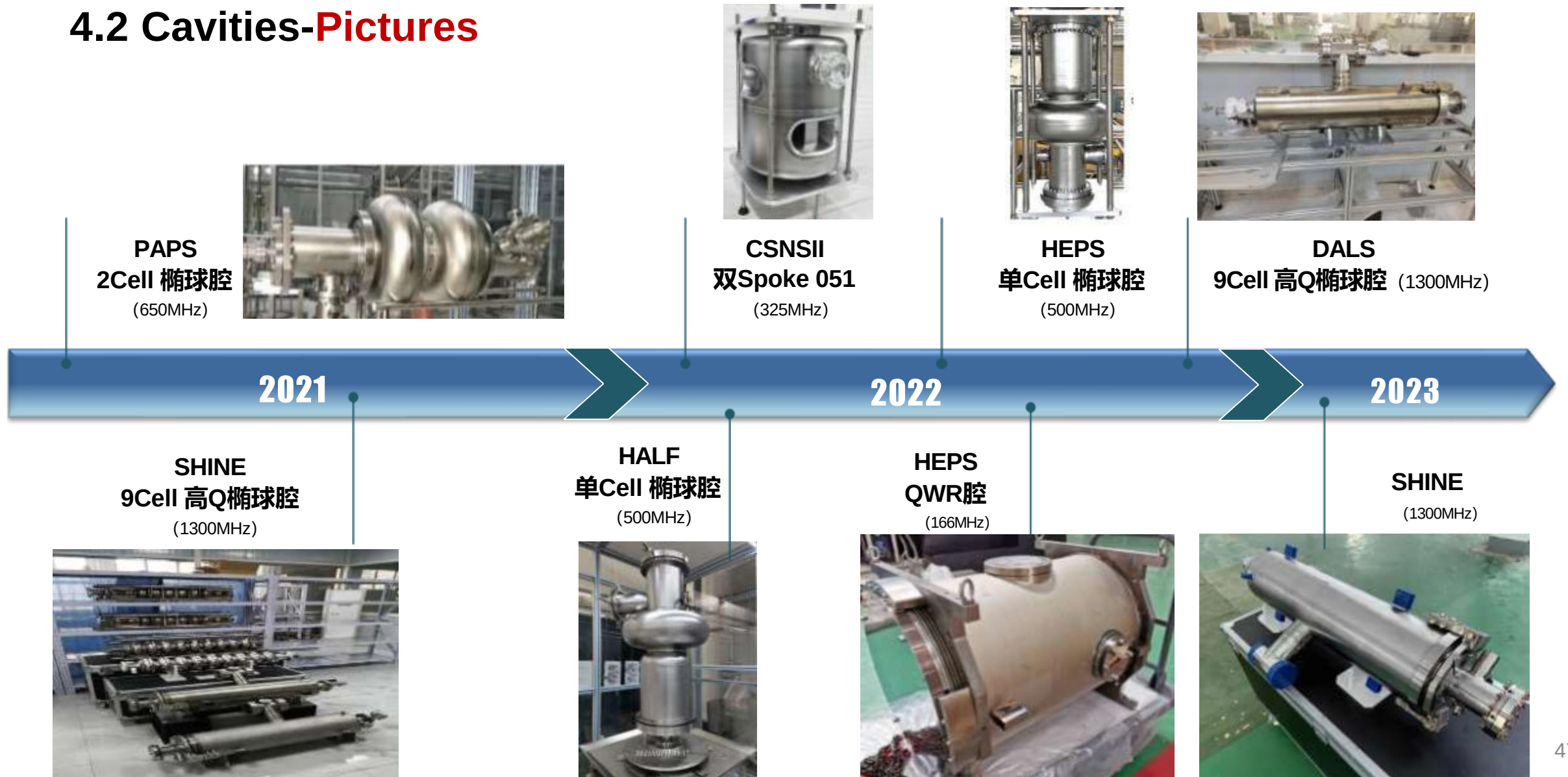
Cavity
HLS 超导腔
(500MHz)



SRF Cavities

4. SRF Cavities Couplers and Cryomodules

4.2 Cavities-Pictures



4. SRF Cavities Couplers and Cryomodules

4.2 Cavities-Pictures

CSNSII
双Spoke 051
(325MHz)



CSNSII
6Cell 椭圆腔
(648MHz)

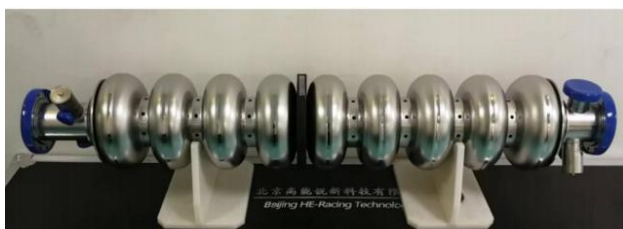


HALF
1Cell 椭圆腔 (1500MHz)



2024-2025

SHINE
9Cell 高Q椭圆腔
(1300MHz)



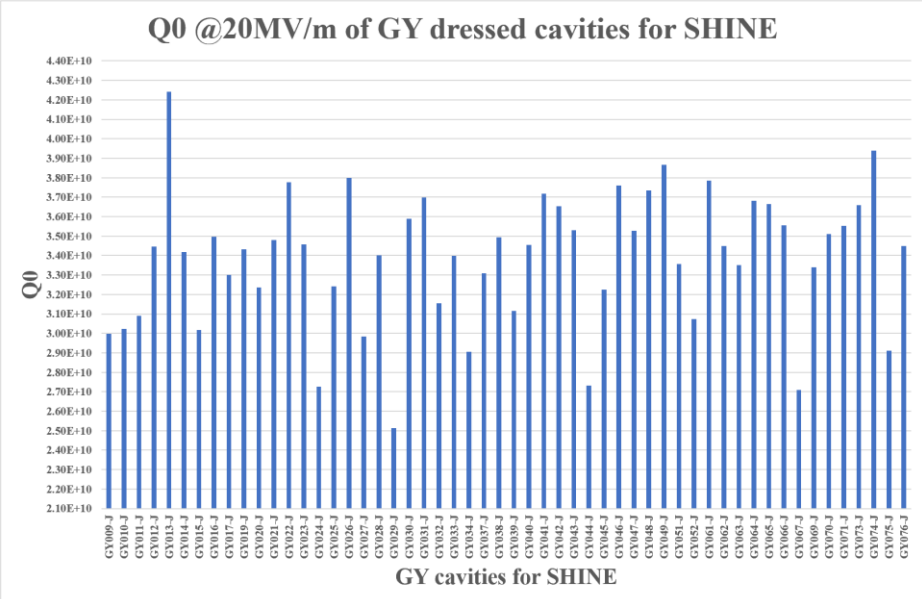
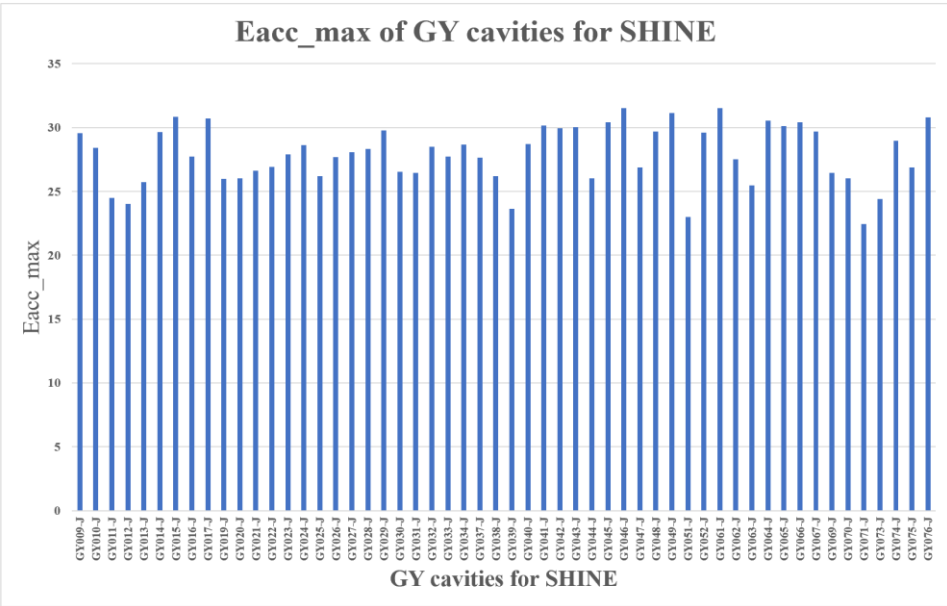
5Cell 椭圆腔
(975MHz)



4. SRF Cavities Couplers and Cryomodules



2.1 Cavities(1.3GHz 9 cell cavities)



4. SRF Cavities Couplers and Cryomodules

4.3 Couplers-Parameters List (80 Pieces)

Item	Facility	Cavity Type	Frequency (MHz)	Window Type	Qty.	Remark	Power
1	SERI	DTL(NC)	80	Coaix, Plate	2	Online	
2	IBS	HWR (SCC)	162.5	Coaix, Plate	2	Test	
3	CiADS	HWR (SCC)	162.5	Coaix, Plate	2	Online	CW 15kW
4	HEPS-TF	QWR (SCC)	166.7	Coaix, Plate	2	Test	
5	HEPS	QWR (SCC)	166.7	Coaix, Plate	10	Online	TW250kW,SW100kW
6	CSNS	Spoke (SCC)	324	Coaix, Plate	2	Test	TW300kW , 5%
7	CiADS	RFQ (NC)	325	Coaix, Plate	8	Online	
8	CiADS	Spoke (SCC)	325	Coaix, Plate	7	Online	CW,10kW
9	CiADS	Buncher (NC)	325	Coaix, Plate	3	Online	CW,7kW
10	CSNS	RFQ (NC)	325	Coaix, Plate	5	Online	
11	BNCT	RFQ (NC)	325	Coaix, Plate	5	Online	95kW, 80%
12	BEPCII	1 cell (SCC)	500	Coaix, Plate	4	Online	TW,250kW,SW,100kW
13	HEPS	5Cell (NC)	500	Coaix, Plate	2	Test	TW 250kW,SW 波100kW
14	PAPS	2Ccell (SCC)	650	Cylinder	2	Test	
15	ILC R&D	9cell (SCC)	1300	Cylinder	2	Test	
16	SHINE	9cell (SCC)	1300	Cylinder	8	Test	CW14kW;SW7kW
17	DALS	9cell (SCC)	1300	Cylinder	8	HT	CW14kW;SW7kW
18	SHINE	9cell (SCC)	1300	Cylinder	4	Test	CW14kW;SW7kW

4. SRF Cavities Couplers and Cryomodules

4.3 Couplers-Pictures



325MHz-ADS



324MHz-CSNS



162.5MHz-CADS



325MHz-ADS



500MHz-BEPCII

2012

2013

2014

2015

2016

4. SRF Cavities Couplers and Cryomodules

4.3 Couplers-Pictures



1.3GHz



352MHz-BNCT



650MHz/1.3GHz-CEPC



1.3GHz-SHINE



166.6MHz-HEPS TF

2017

2018

2019

4. SRF Cavities Couplers and Cryomodules

4.3 Couplers-Pictures



325MHz-R ISP



500MHz



324MHz



166MHz-HEPS



1300MHz-DALS/SHINE



CSNS 325MHz

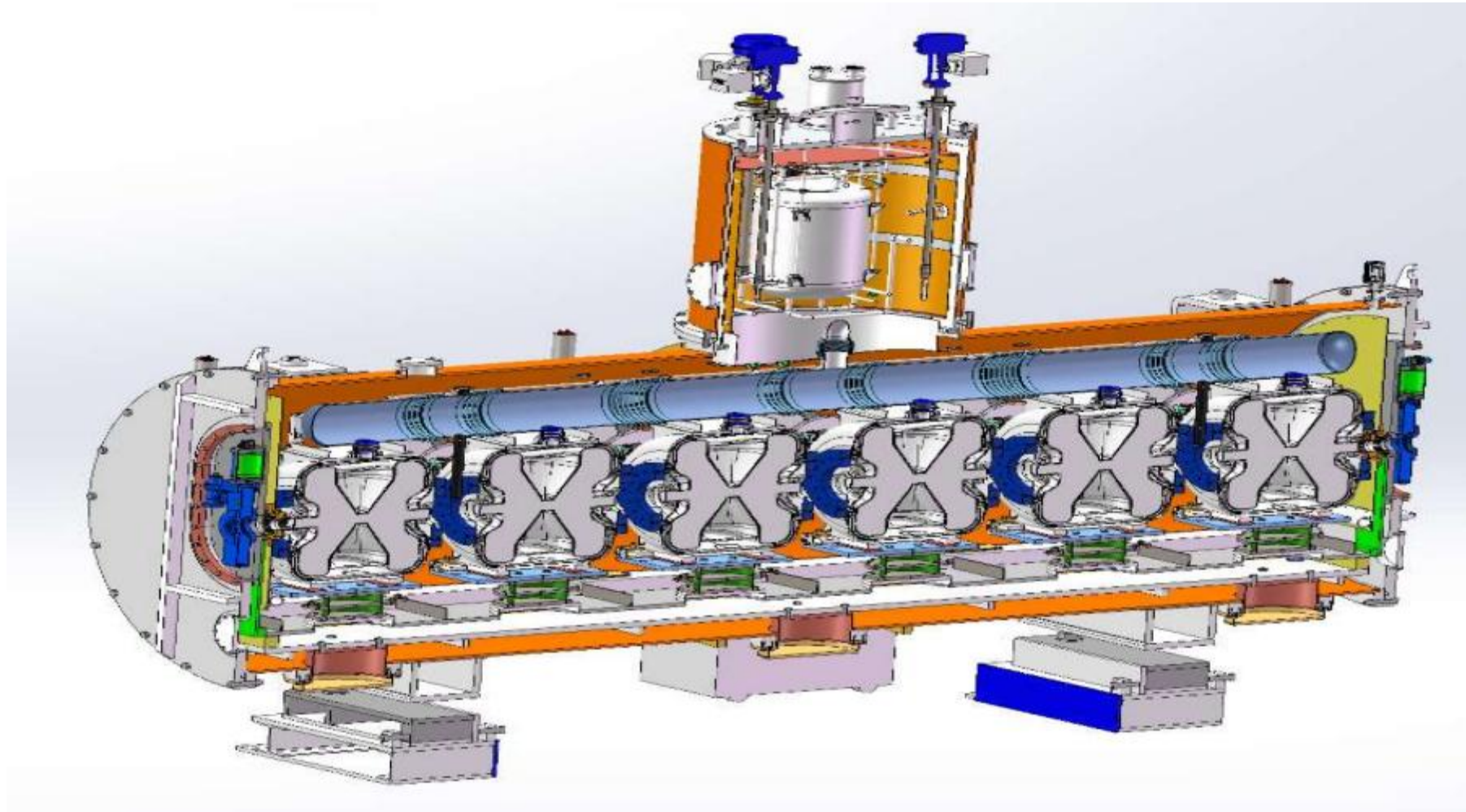
2020

2021

2022-2023

4. SRF Cavities Couplers and Cryomodules

4.4 SSR2 Spoke 325MHz Cavity cryomodule-3D model



4. SRF Cavities Couplers and Cryomodules

4.4 SSR2 Spoke 325MHz Cavity cryomodule-Assembly at RISP



Cavity string alignment



Cryomoduel complete

4. SRF Cavities Couplers and Cryomodules

4.5 Double Spoke 325MHz Cavity cryomodule-Cavities VT

CSNS-II SRF Cavities

	324 MHz Double Spoke Resonator	648 MHz 060 5-cell Elliptical Cavity	Units
Frequency	324	648	MHz
β_g or β_{opt}	0.5 (β_{opt})	0.6 (β_g)	
Beam aperture	50	96/130	mm
E_p/E_{acc}	3.72	2.76	
B_p/E_{acc}	7.83	5.14	mT/(MV/m)
R/Q	451	274.8	Ω
$E_{acc}(\text{Max.})$	9	16	MV/m
$V_{acc}(\text{Max.})$	6.25	11.152	MV



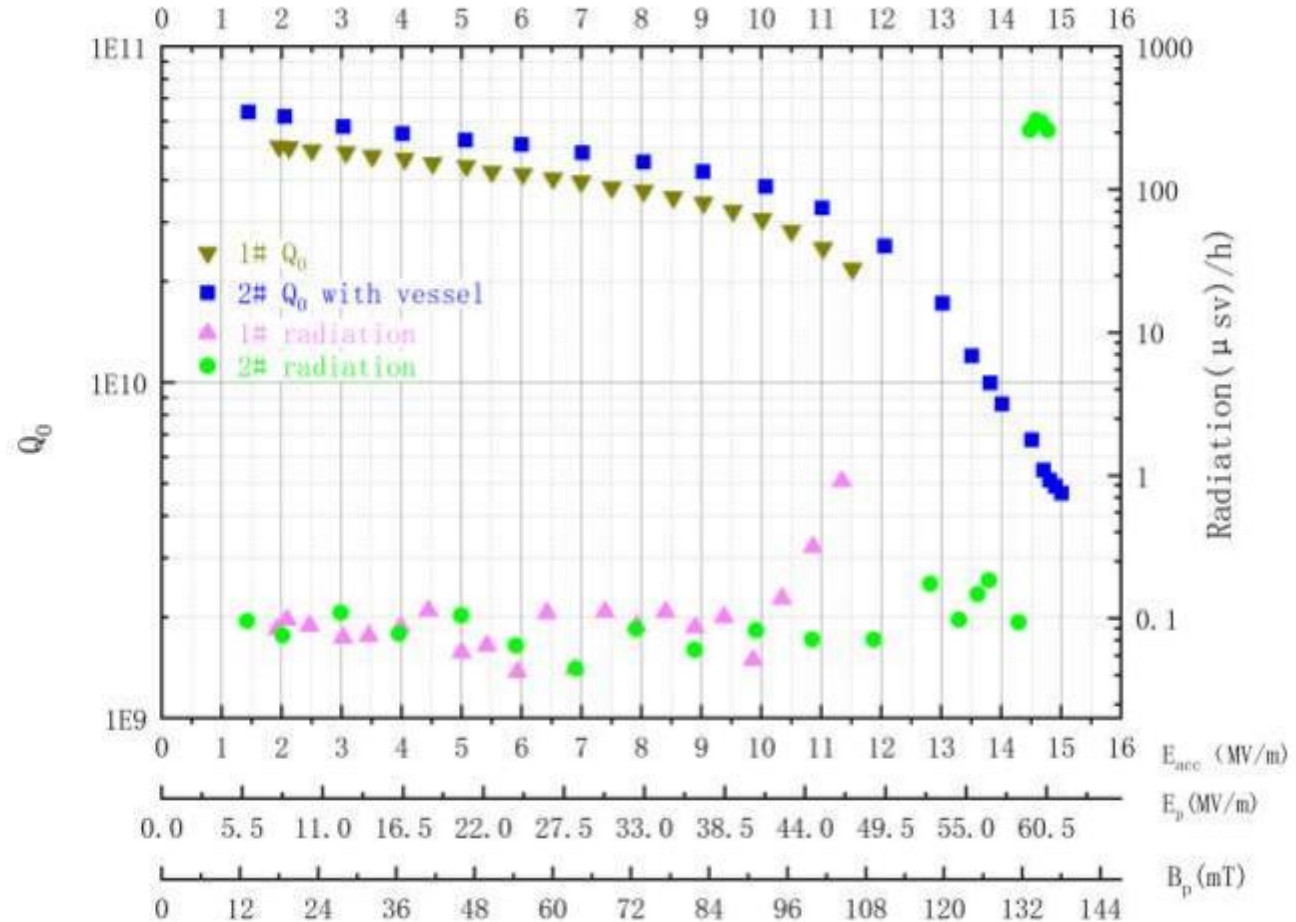
20 Spoke Cavities for CSNS-II

4. SRF Cavities Couplers and Cryomodules

4.5 Double Spoke 325MHz Cavity cryomodule-Cavities VT



Cavity HPR



VT Results

4. SRF Cavities Couplers and Cryomodules

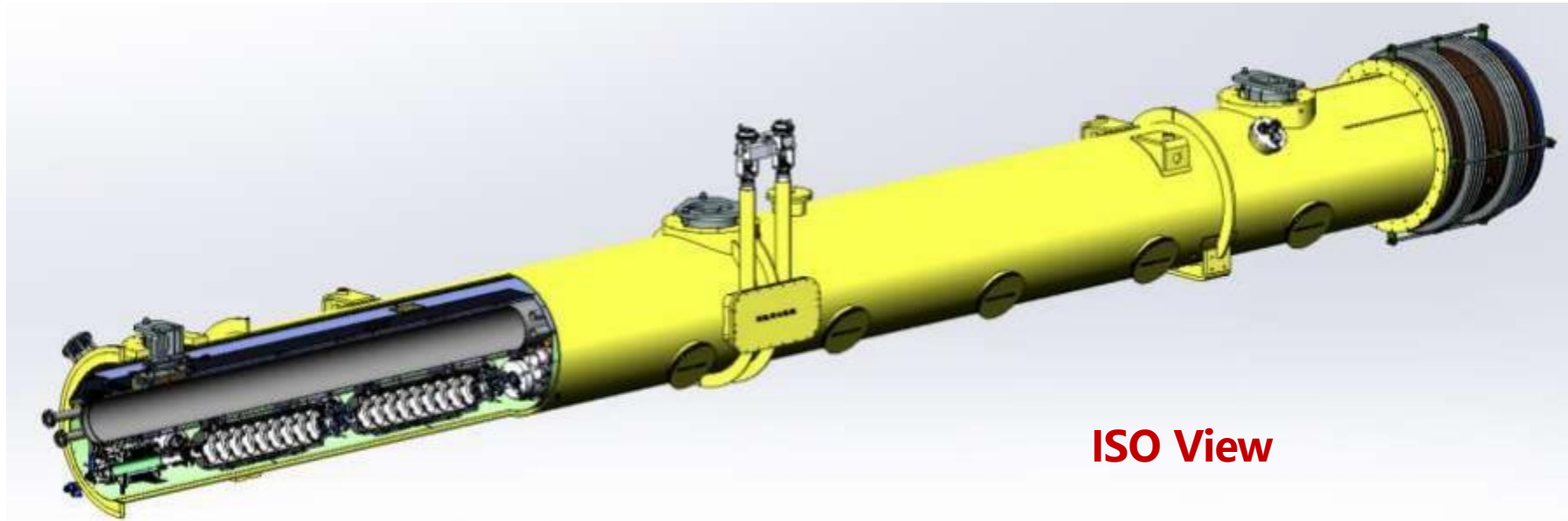
4.5 Double Spoke 325MHz Cavity cryomodule- Cryomodule



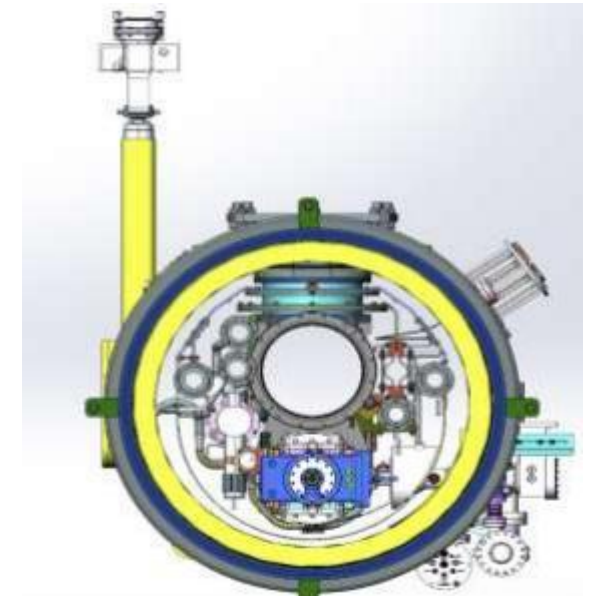
General Assembly

4. SRF Cavities Couplers and Cryomodules

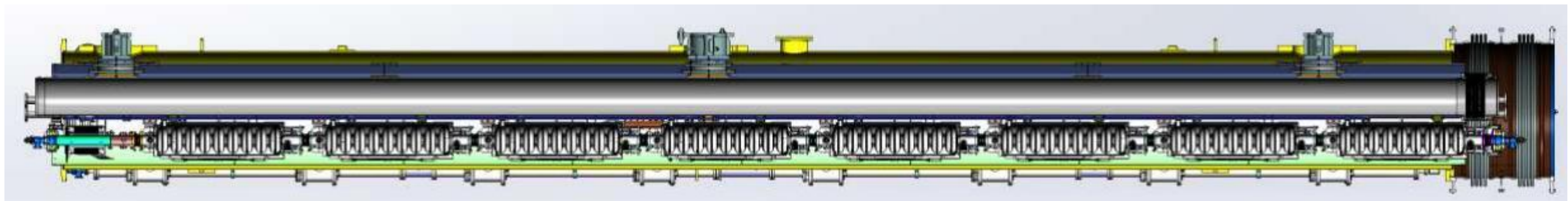
4.6 1.3GHz cryomodule-3D model



ISO View



Cross Section View



LongitudinalSection View

4. SRF Cavities Couplers and Cryomodules

4.6 1.3GHz cryomodule-General assembly



Cryomodule assembly and HT test was finished.

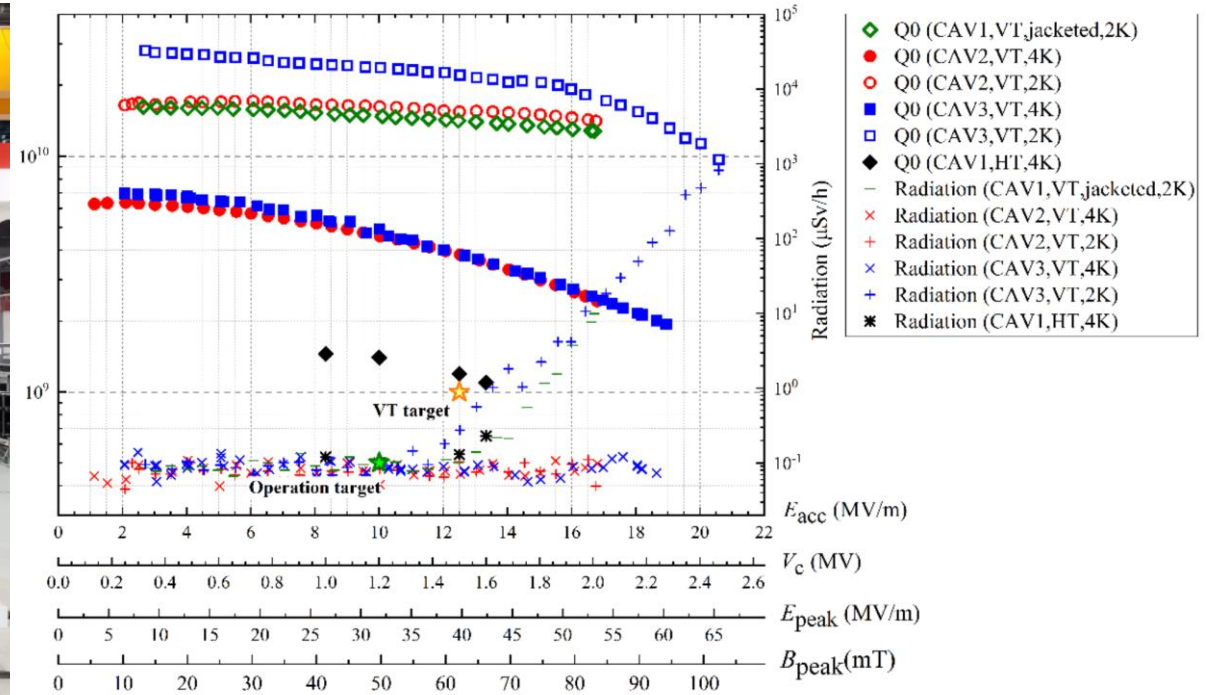
Q0 3.8E10@16MV/m; 3.6E10@21MV/m;
Average Max. Eacc 23.1MV/m

Key process:

- (1) HPR cavity before assembly;**
- (2) Do RT coupler conditioning before cooling down;**
- (3) Optimize anchor connection;**

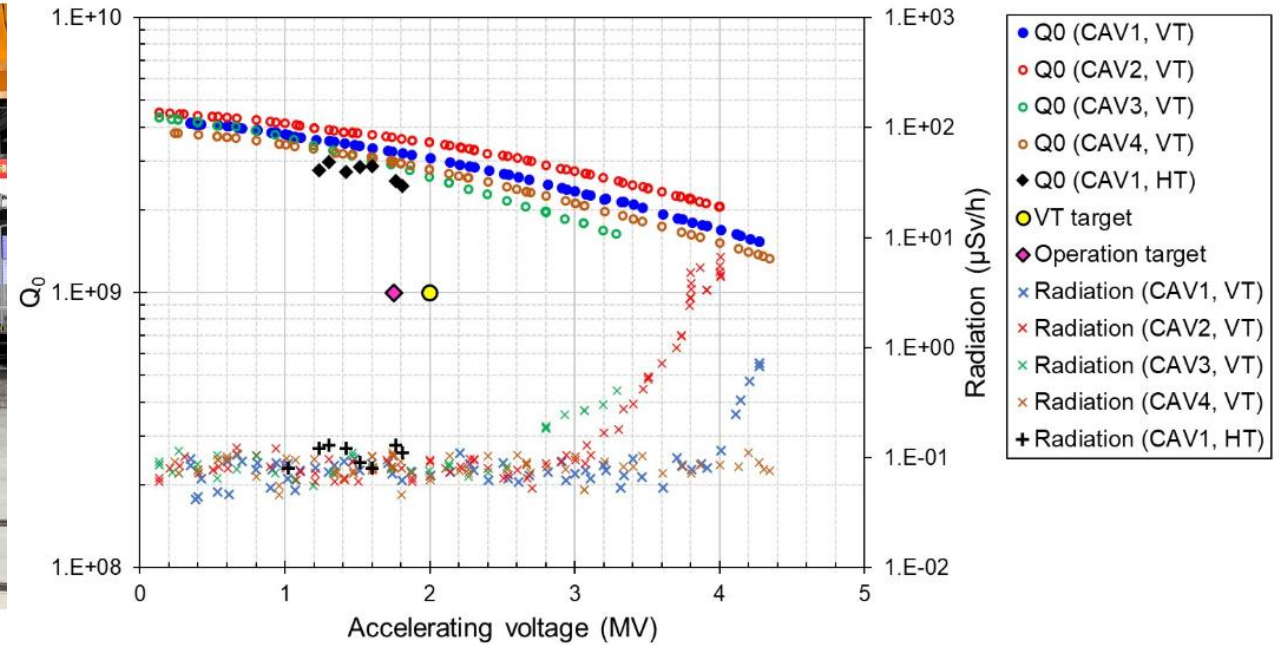
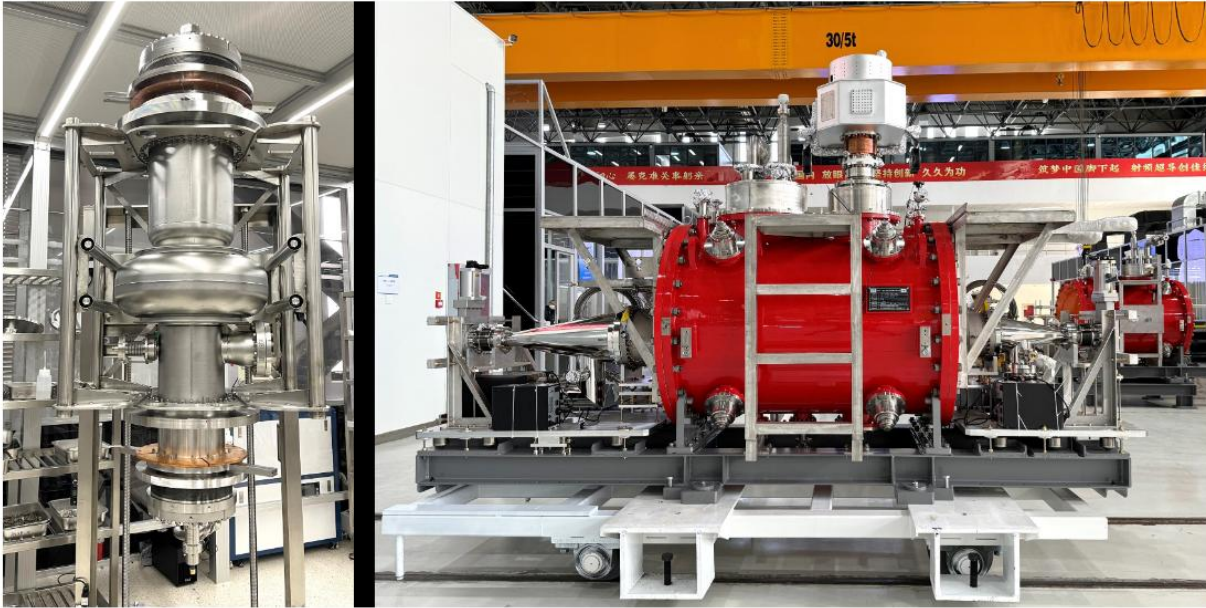
4. SRF Cavities Couplers and Cryomodules

4.7 166MHz cryomodule (HEPS)



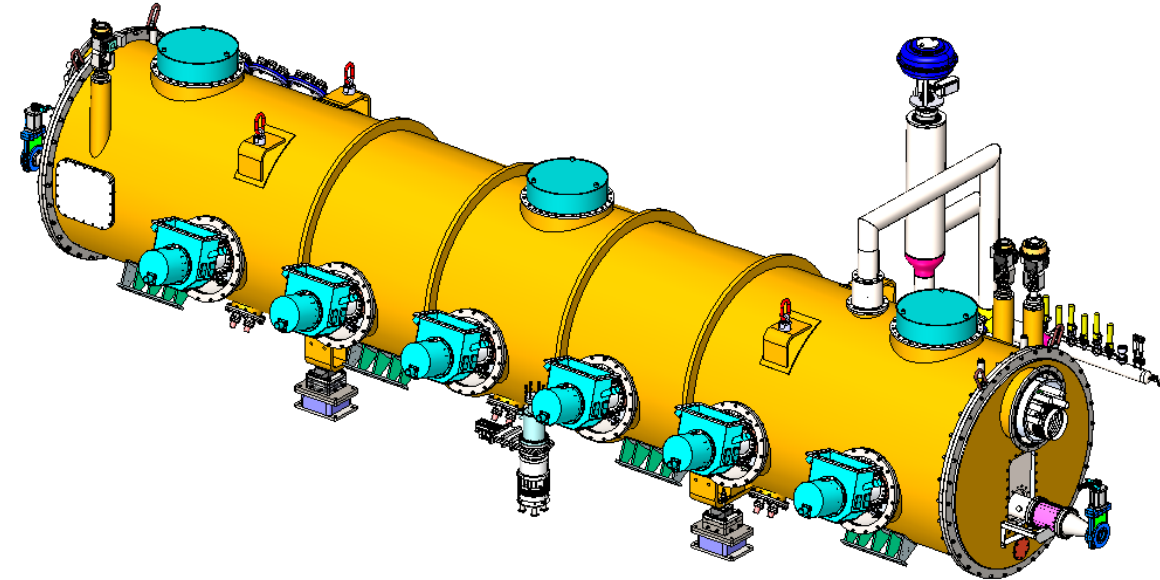
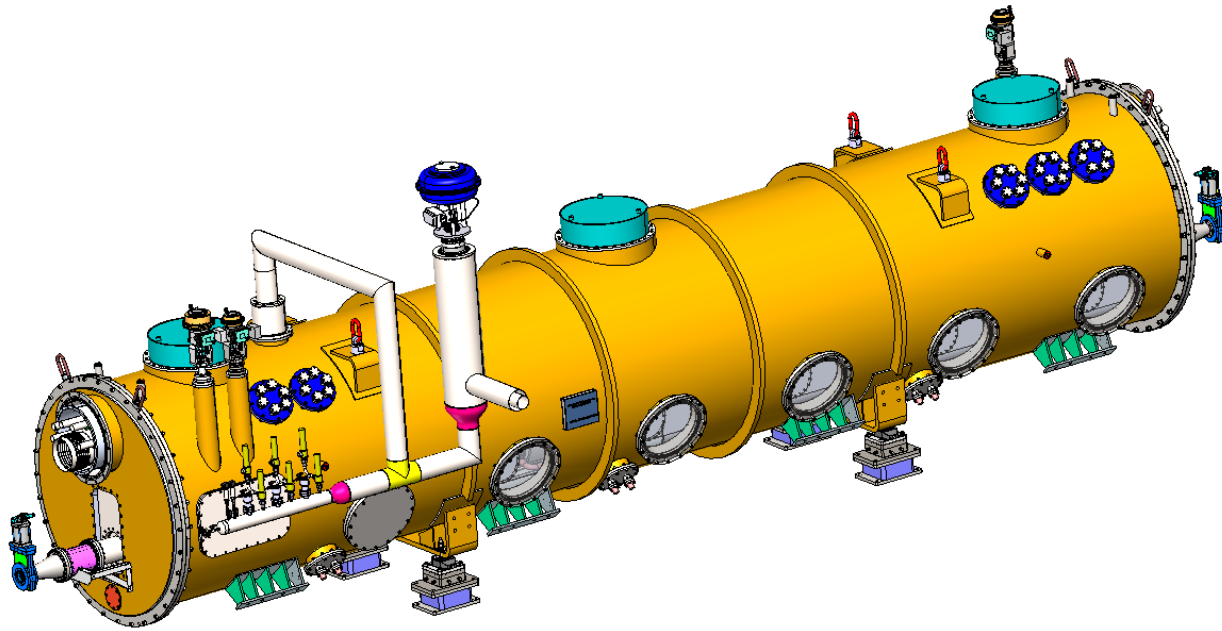
4. SRF Cavities Couplers and Cryomodules

4.8 500MHz cryomodule (HEPS)



4. SRF Cavities Couplers and Cryomodules

4.9 650MHz cryomodule (CEPC)



4. SRF Cavities Couplers and Cryomodules

4.9 650MHz cryomodule (CEPC)



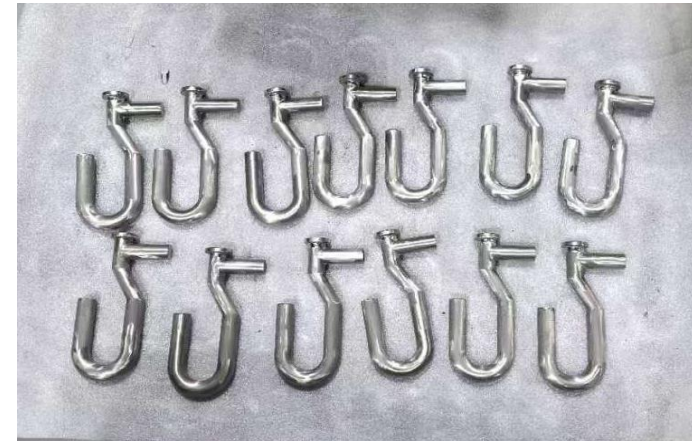
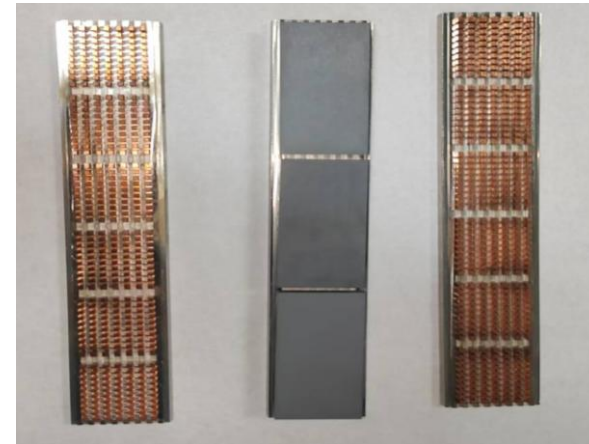
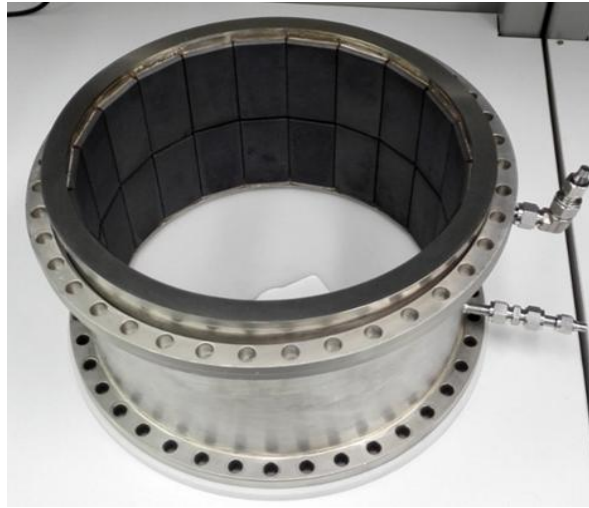
Cavity



Coupler

4. SRF Cavities Couplers and Cryomodules

4.9 650MHz cryomodule (CEPC)



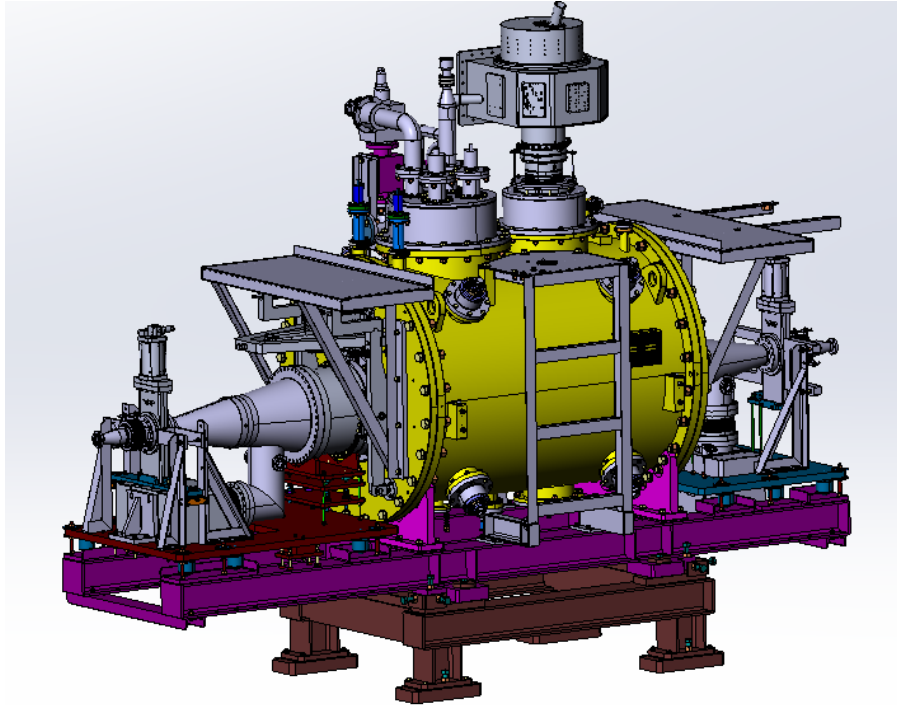
HOM Coupler(Cu)

Absorber

HOM Coupler(Nb)

4. SRF Cavities Couplers and Cryomodules

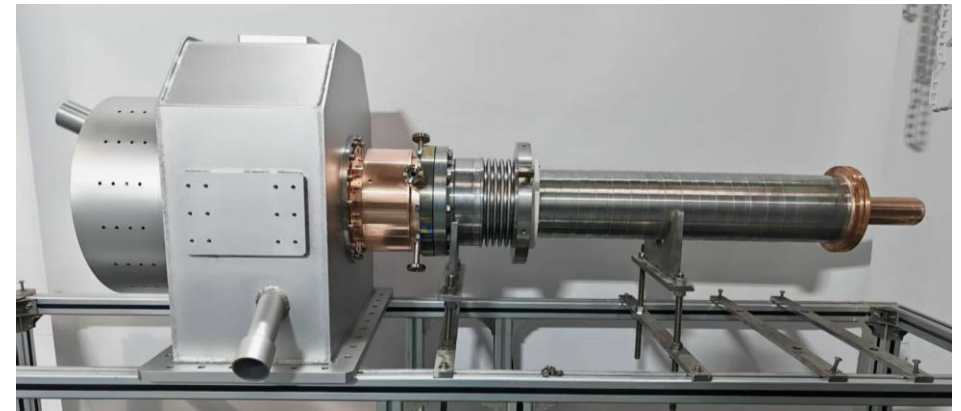
4.10 500MHz cryomodule (HALF)



Cryomodule



Cavity



Coupler

5. Facilities Serviced by HERT

- CSNSII (Dongguan, Guangdong province)-**Cavities and Couplers**



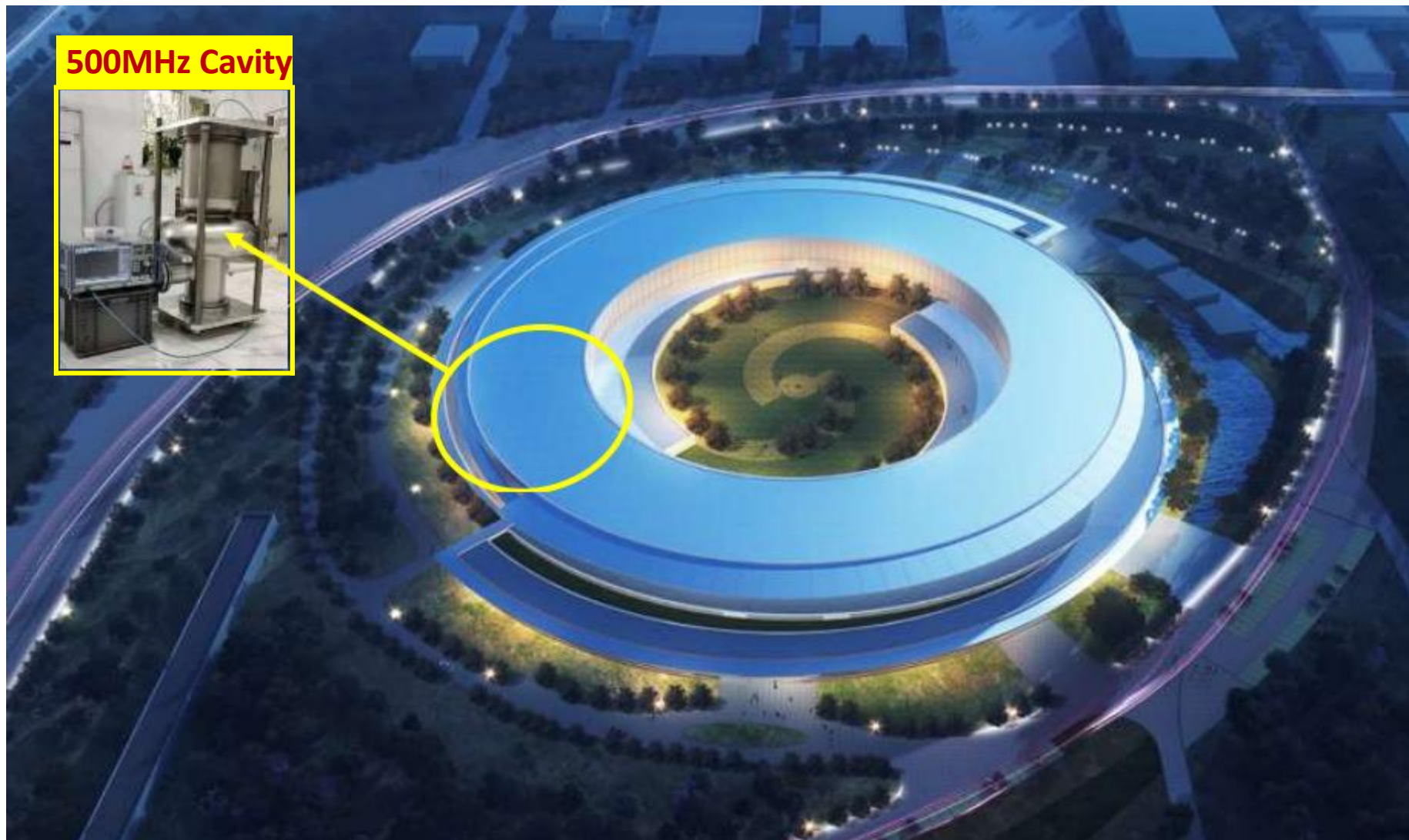
5. Facilities Serviced by HERT

■ HEPS (Beijing)-Cavities and Couplers



5. Facilities Serviced by HERT

- HALF (Hefei, Anhui province)-**Magnets and Cavities**



5. Facilities Serviced by HERT

■ SHINE (Shanghai)-Cavities and Couplers



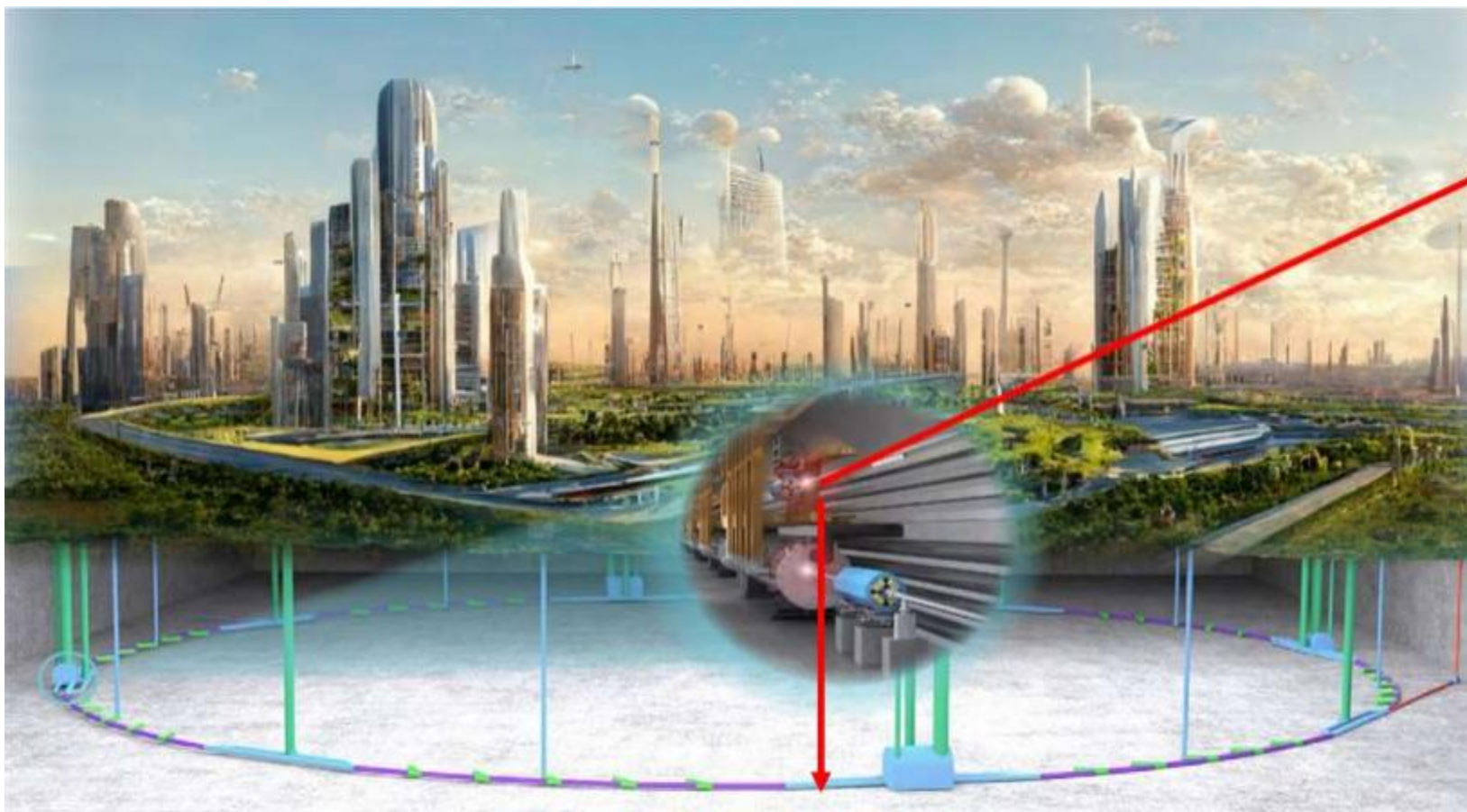
5. Facilities Serviced by HERT

■ S3FEL (Shenzhen, Guangdong province)-Cryomodules



5. Facilities Serviced by HERT

■ CEPC research – Cavities and Couplers



1300MHz 9Cell cryomodule



650MHz 2Cell cryomodule



5. Facilities Serviced by HERT

■ PAPS operation (20 staff of HERT)



5. Facilities Serviced by HERT

■ PAPS operation (20 staff of HERT)



5. Facilities Serviced by HERT

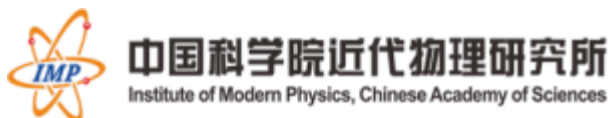
■ PAPS operation (20 staff of HERT)



6. Summary

- **HERT full with the experience for accelerator key technology and components R&D and manufacture.**
- **HERT has Successfully developed the magnets, accelerating structure, SRF cavities ,couplers and cryomodule for HEPS.**
- **HERT is willing to undertake more R&D work for all institutes, universities and labs.**

6. Summary



Thanks for your attention!



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.