Efforts on the R&D of SRF cavity at Peking University

SRF Group
Institute of Heavy Ion Physics, Peking University

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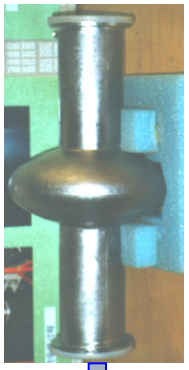
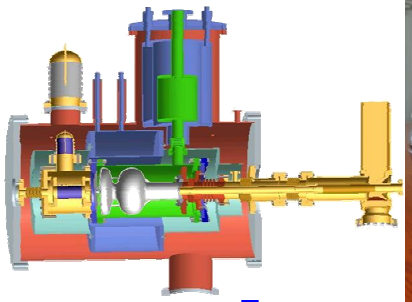
- Cavities made by Peking University
- Development of relative techniques
- Future plan

Cavities made by Peking University

Development of SRF at PKU





2×3.5cell

2×9cell

大晶粒铌
材超导腔

SRF group

1988

1994

2000

2002

2004

2005

2006

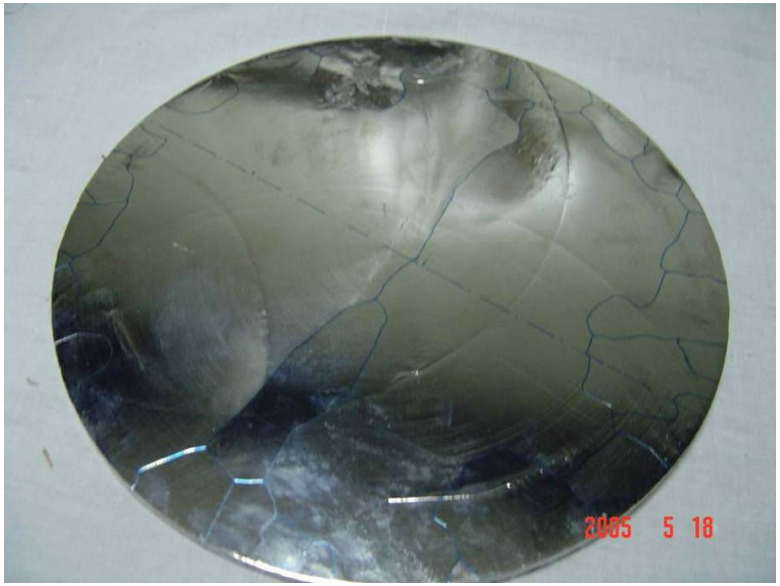
2007

2008

2009

L-G Nb Cavities made by Peking University

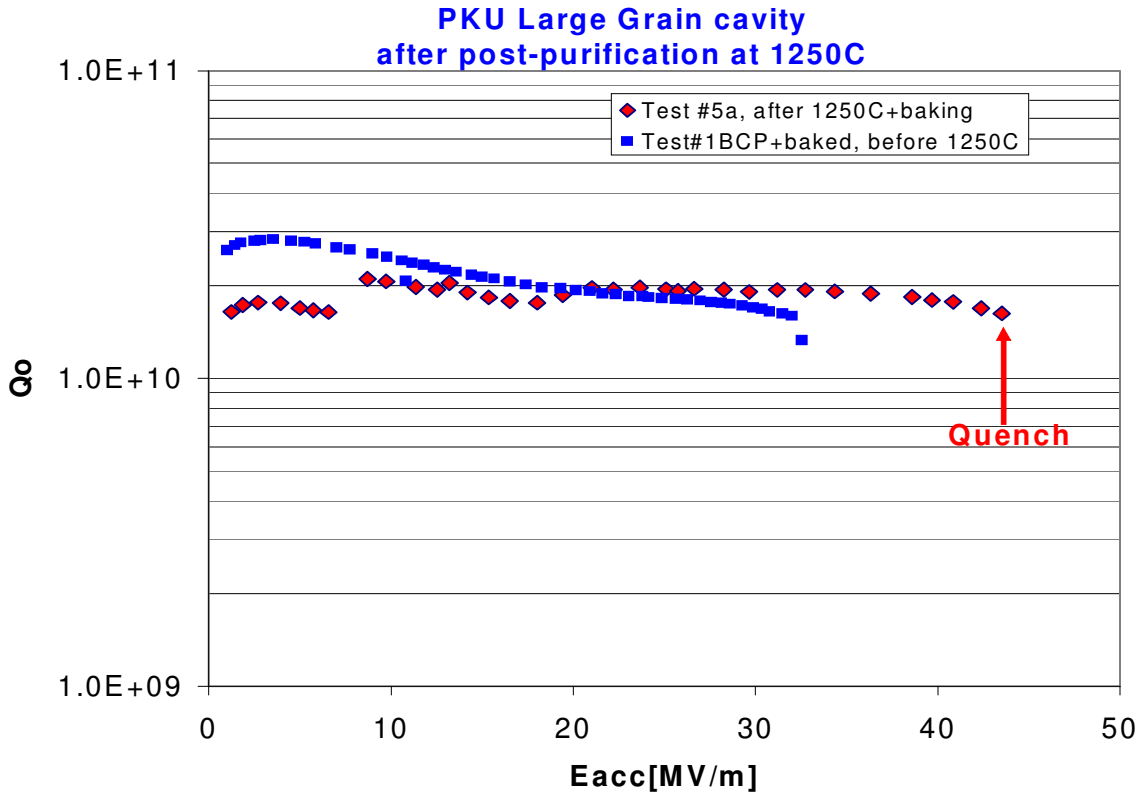
Collaboration with OTIC to develop Large Grain Nb cavity since 2005



- Simplify the machine process of Nb sheets
- Only BCP is needed

L-G Nb Cavities made by Peking University

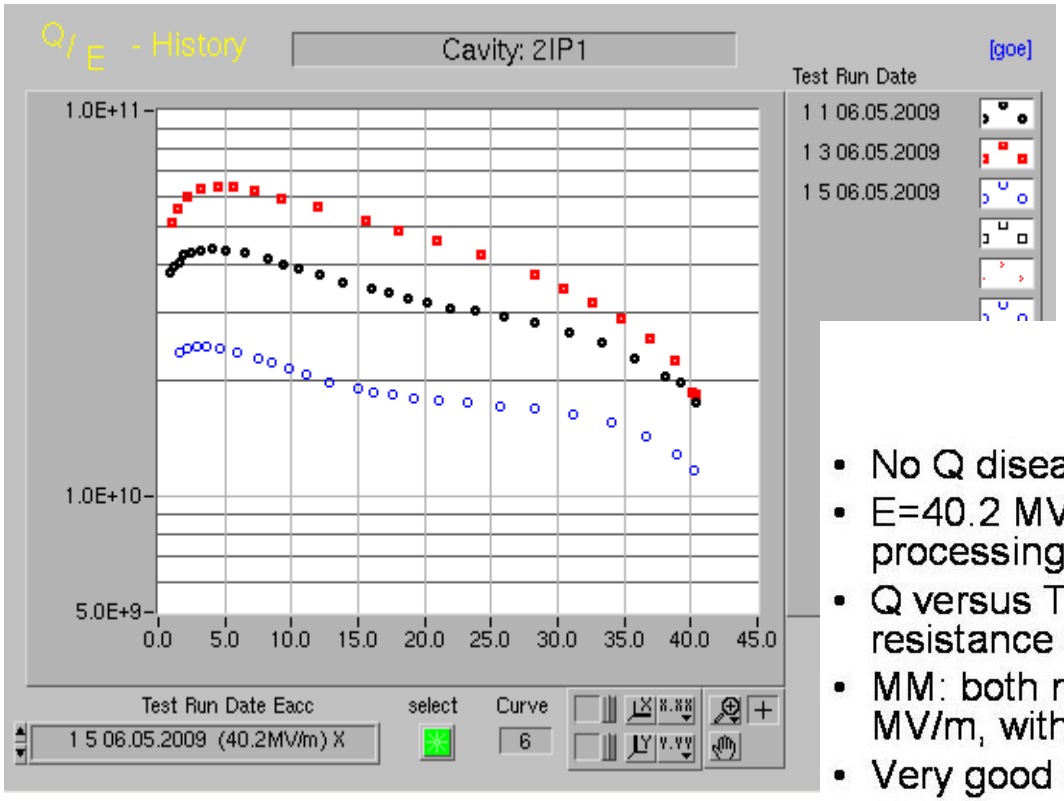
In 2006, acceleration gradient of 1.3GHz Large grain single cell reached 43.5MV/m, Bp=185mT



After BCP treatment & baking at 120^0C for 12 hrs by Dr. P. Kneisel at J-Lab

L-G Nb Cavities made by Peking University

In 2007, large grain 2-cell cavity , 40 MV/m



After 80 μm BCP, HT 800^{0}C, 100 μm EP, 4 x HPR, HT 120^{0}C in Ar atmosphere, kept at 90-140 K for 24 hours

Conclusions:

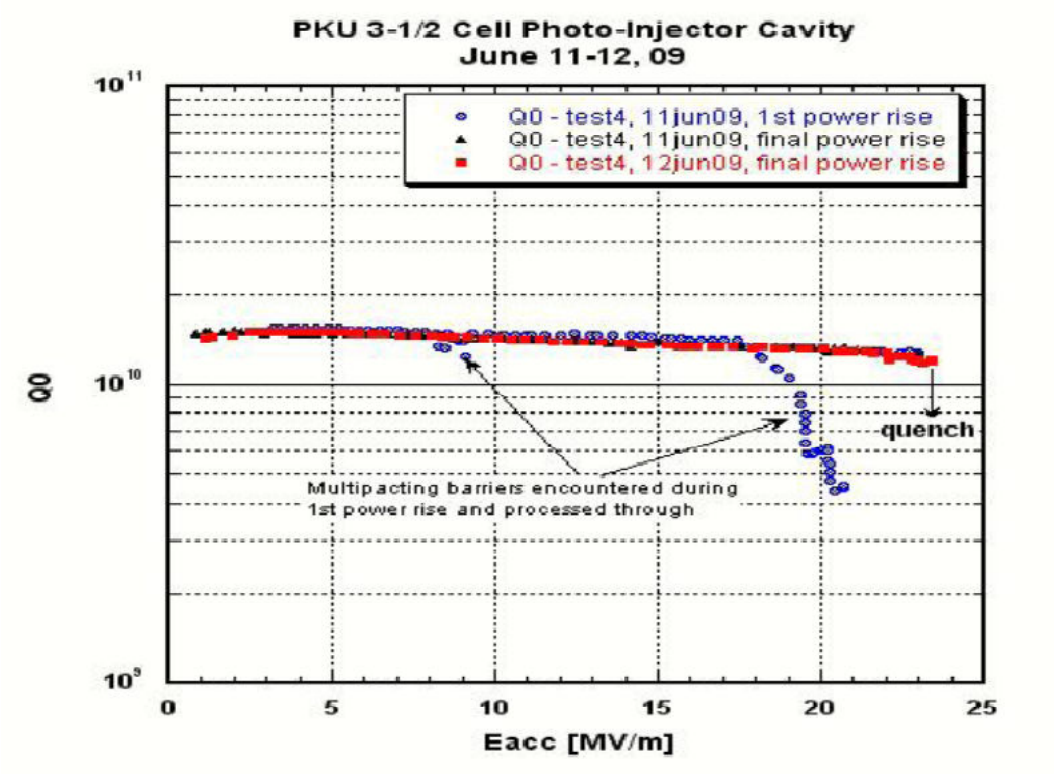
- No Q disease.
- E=40.2 MV/m, Q=1.2·10^{10}, BD, no FE after MP processing in 1st Pi mode run at 1.8 K.
- Q versus T done up to 1.5 K. Residual resistance of Nb material was 4E-9 Ohm.
- MM: both modes limited by BD, at 40 and 44 MV/m, without FE.
- Very good cavity made of a good Nb material.
- China may be a next producer of good superconducting cavities.

Vertical test at DESY

Krzysztof Twarowski

L-G Nb Cavities made by Peking University

In 2009 , 3.5cell large grain cavity, 23.5MV/m

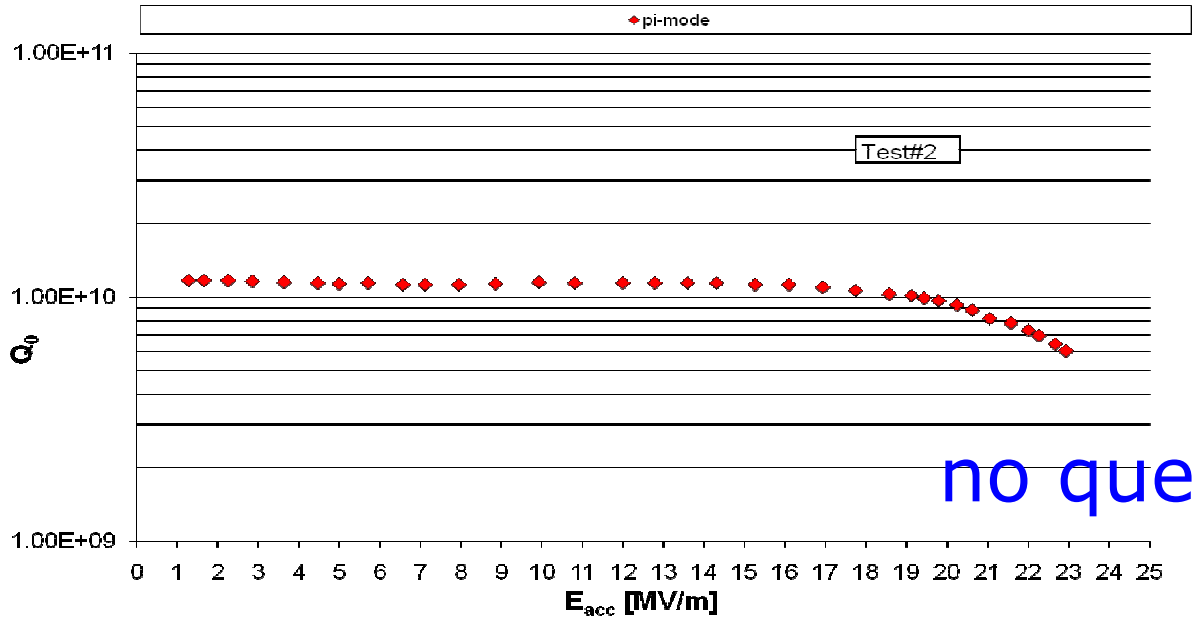


Vetical test at JLab

Large grain 3.5 cell Nb cavity of 23.5 MV/m @ Q0 >1E10 after BCP, HPR and HT 2 hrs at 800^0c by Dr. R. Geng at J-Lab

F-G Nb Cavities made by Peking University

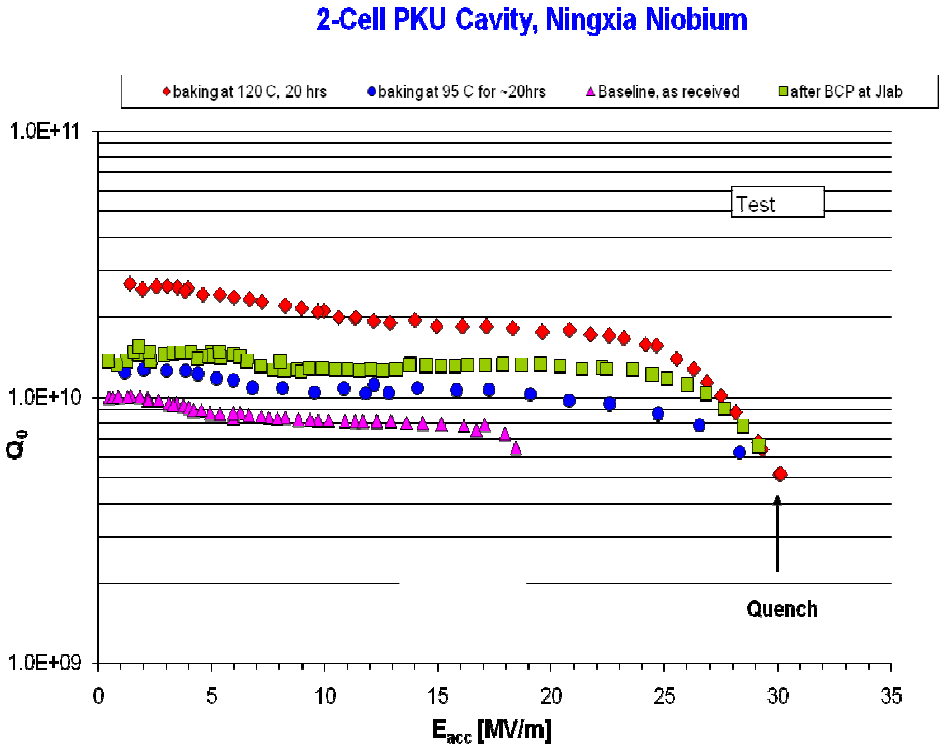
In 2008, first 9-cell cavity in China , Eacc is 23MV/m



no quench

Vertical test at JLab

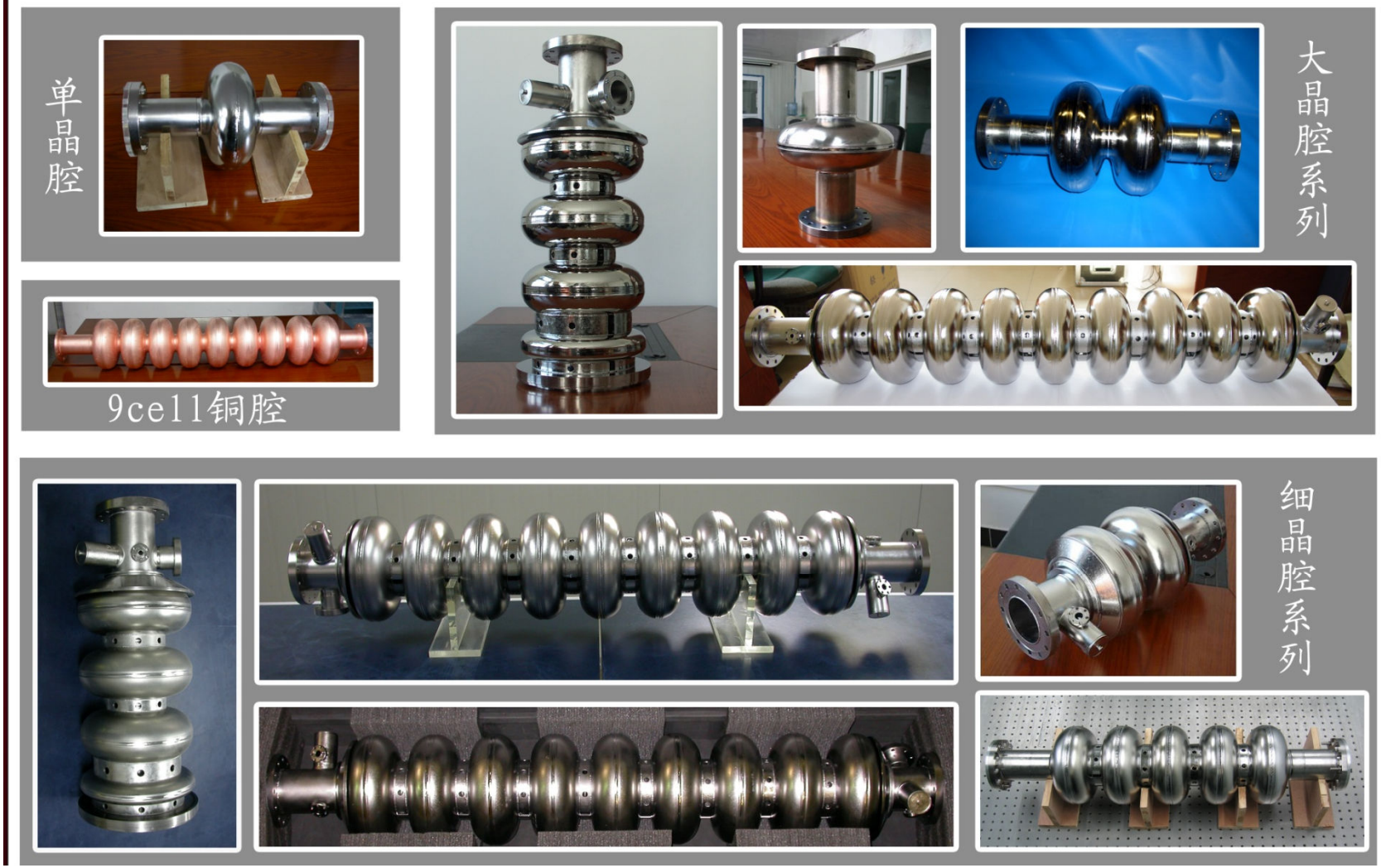
F-G Nb Cavities made by Peking University



Fine grain Nb cavity

Treated & Tested by Dr. P Kneisel at JLab

10 Cavities totally，6 with end group



3 single cell，2 2-Cell，1 5-Cell，2 3.5-Cell，3-9Cell

Development of Relative Techniques for Cavity

Deep drawing and machining of cups

EBW studies: collaboration between HIT (Harbin Institute of Technology) and PKU

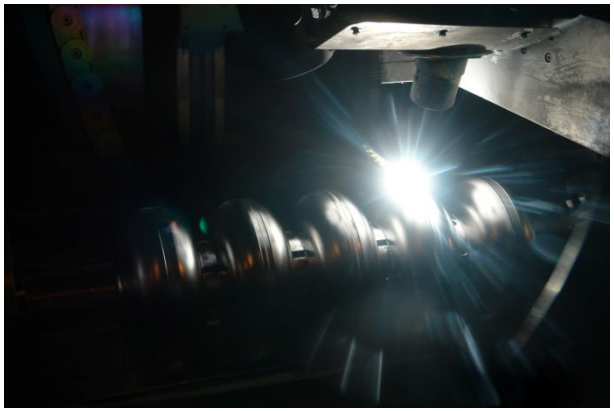
1 EBW machine

2 sample welding

3 dumbbell welding

4 cavity welding

266×1.7(mm)



Development of Relative Techniques for Cavity

RF test and tuning of cups and dumb–bells

Geometrical test

Measure the frequency and coupling factor (k) for the dumb-bell

Measure the frequency of cups

Processing of Nb dumbbells

Cleaning

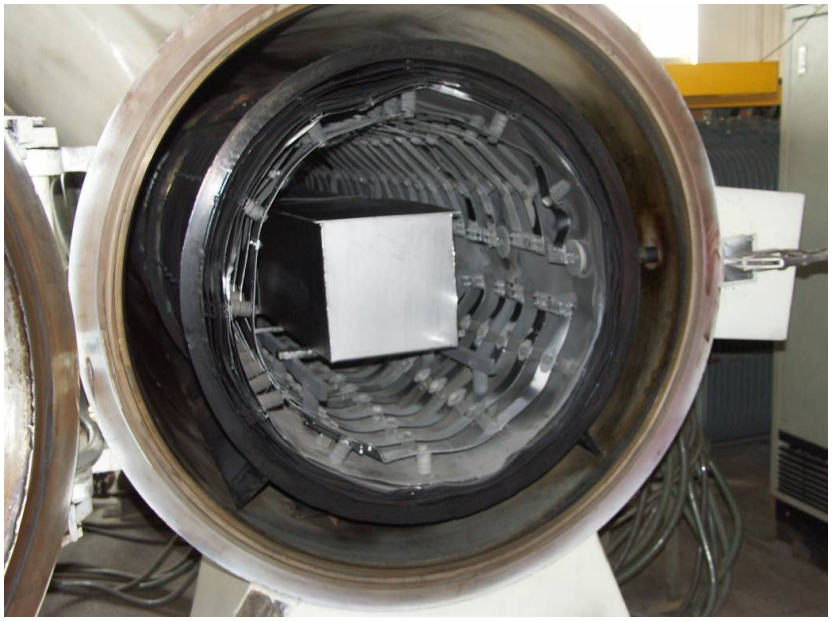
BCP Polishing

Anode oxidizing

Defect detection

Development of Relative Techniques for Cavity

Annealing at 1250°C in Nb box with Ti plate & rod at Ningxia OITC

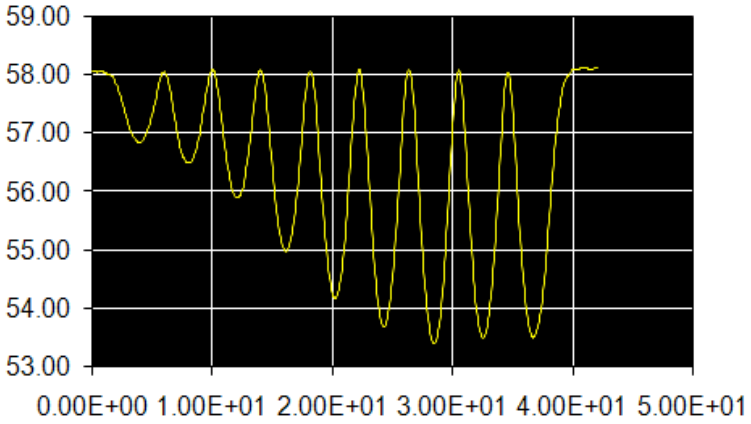


Development of Relative Techniques for Cavity

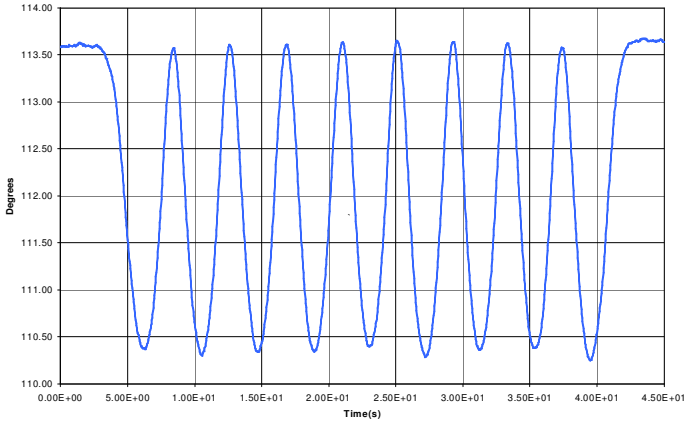
Tuning for 9-cell cavity

SRF cavity tuning facility

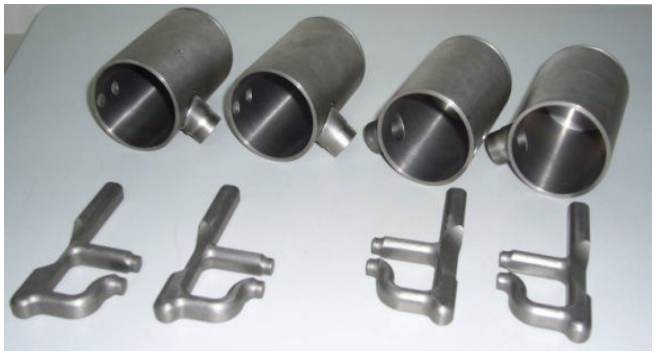
Before Tuning



After Tuning

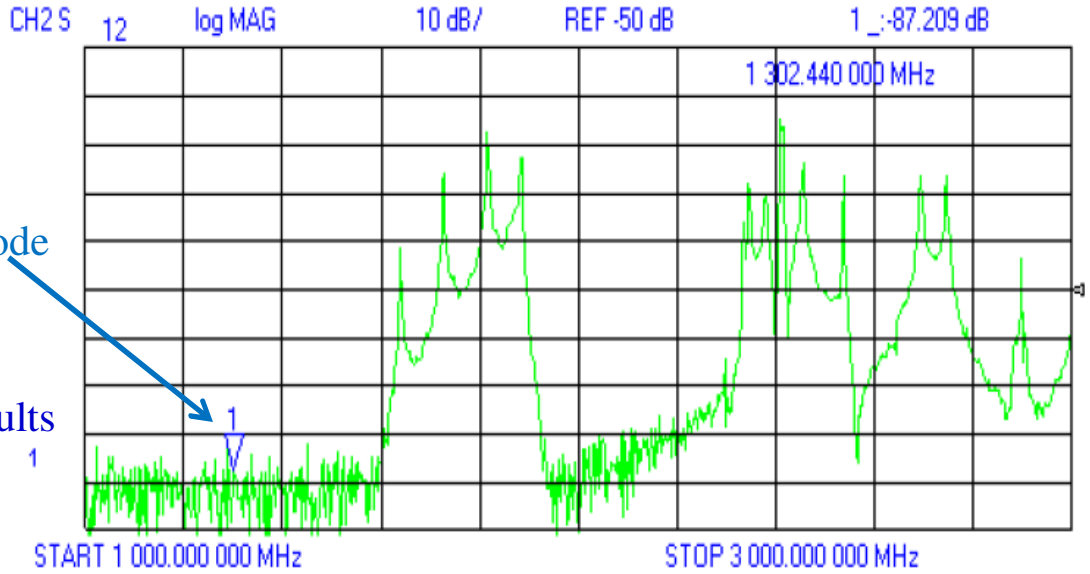


HOM coupler



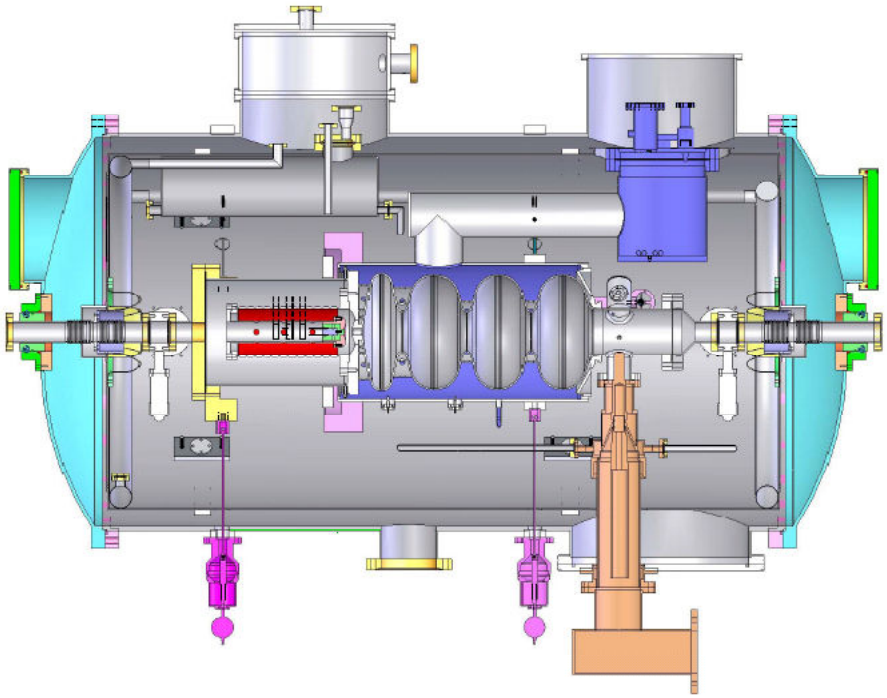
Fundamental mode

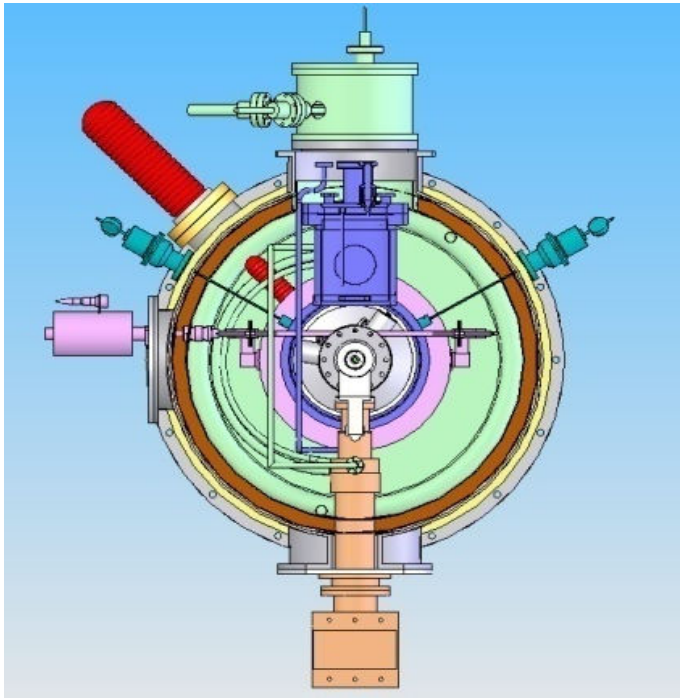
HOM coupler test results



Future Plan

DC-SC photocathode injector

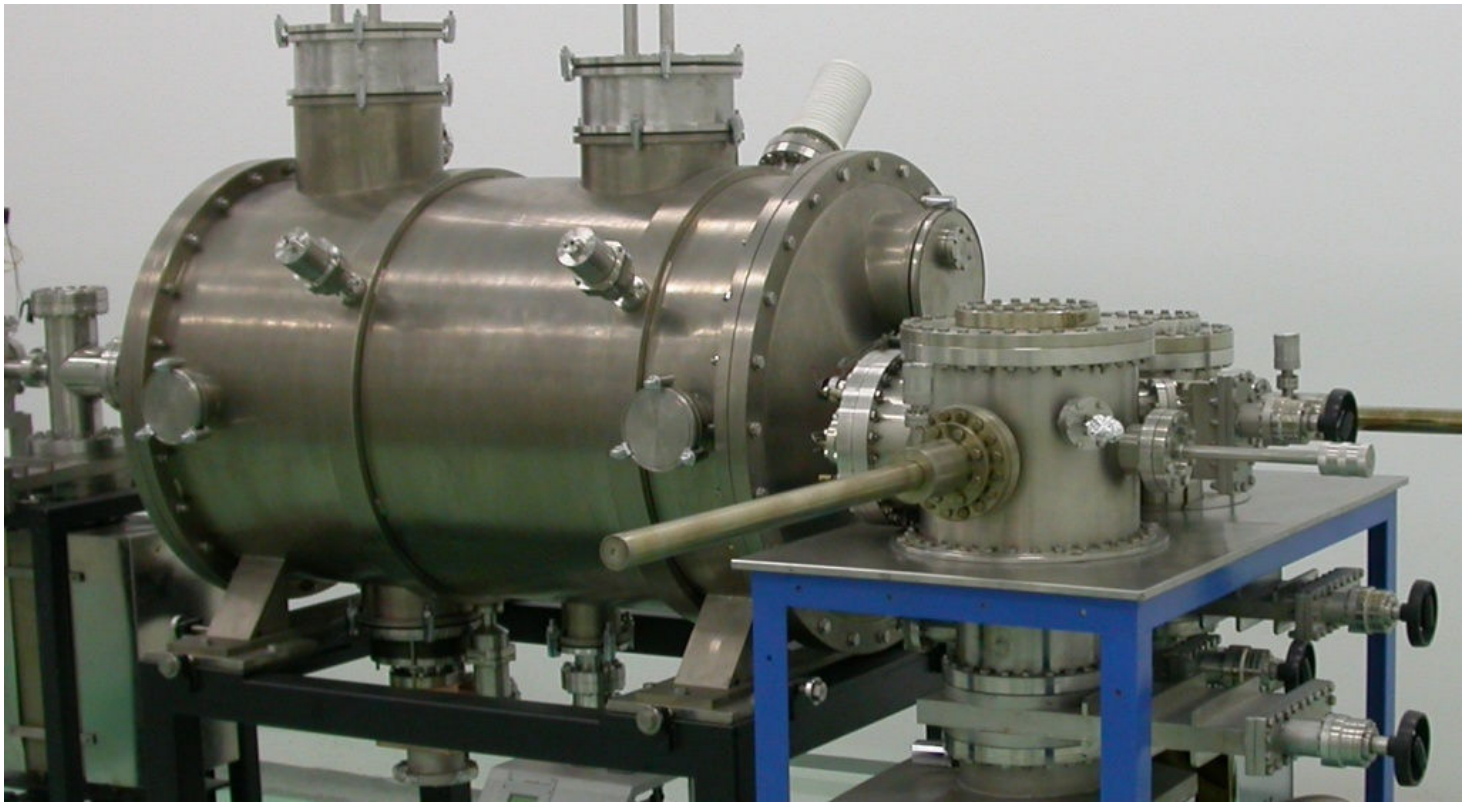




3+1/2 cell cavity is installed in DC-SC photoinjector

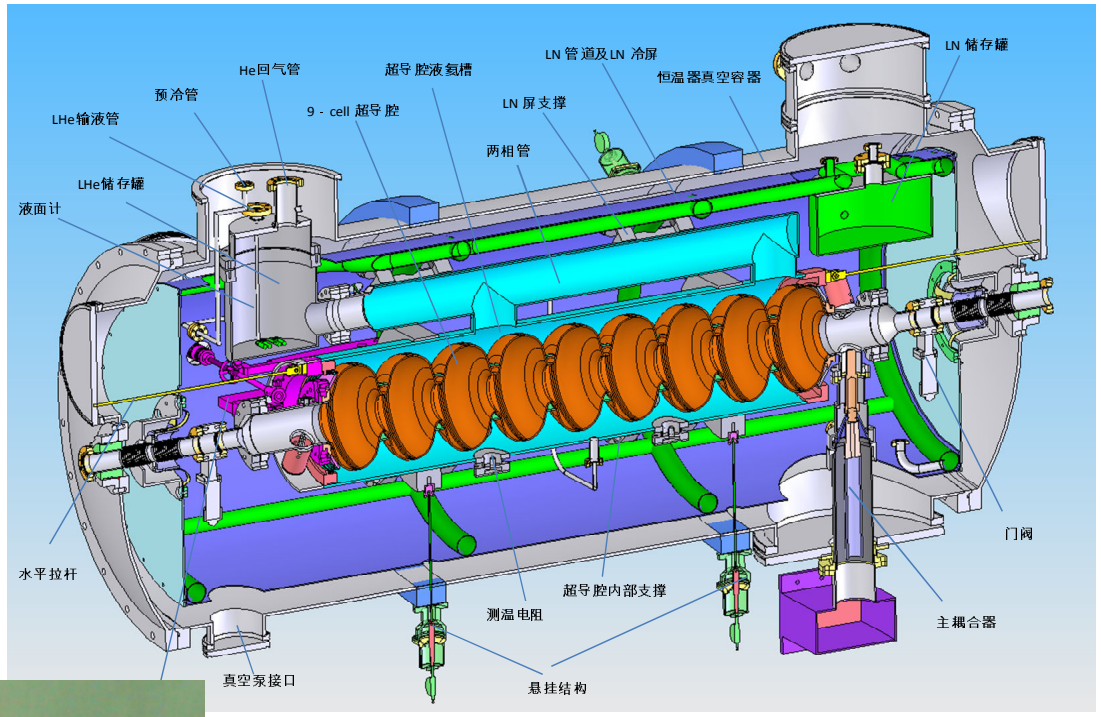
DC-SC photocathode injector

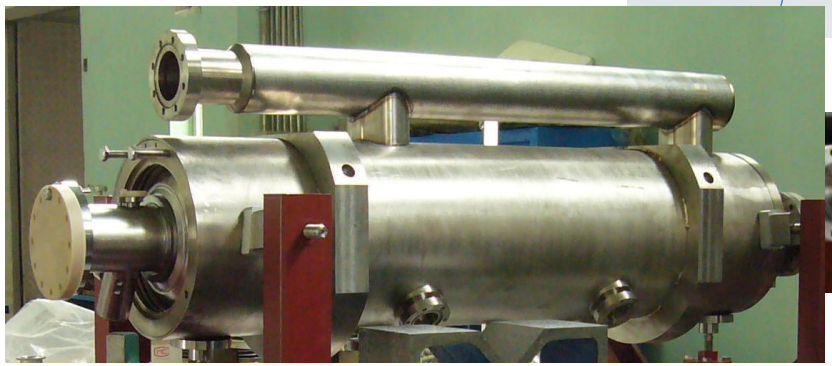
Cryostat of 3.5cell DC-SC photoinjector



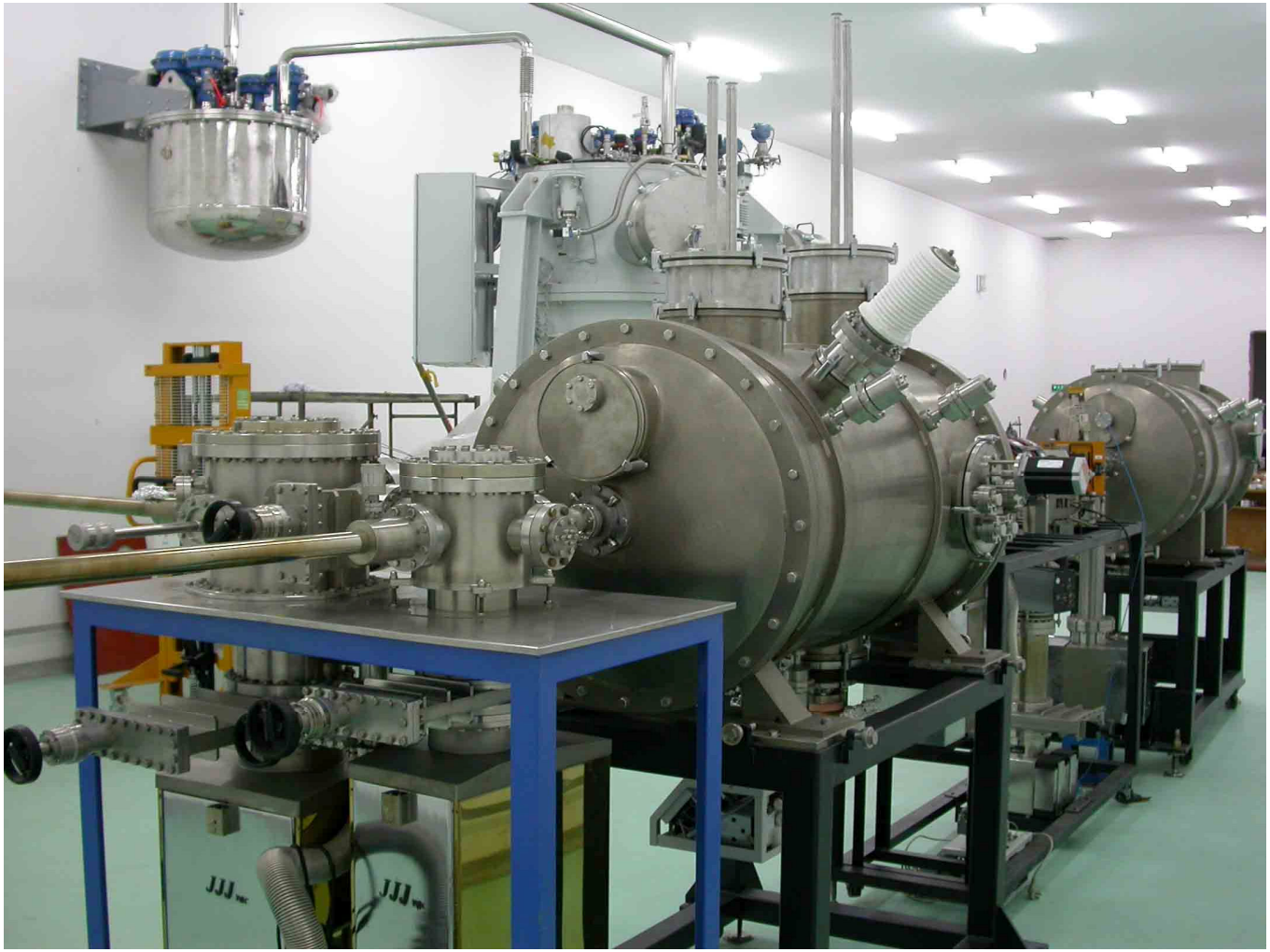
Cryo-modules

9-cell cavity is installed in a Cryo-mudule



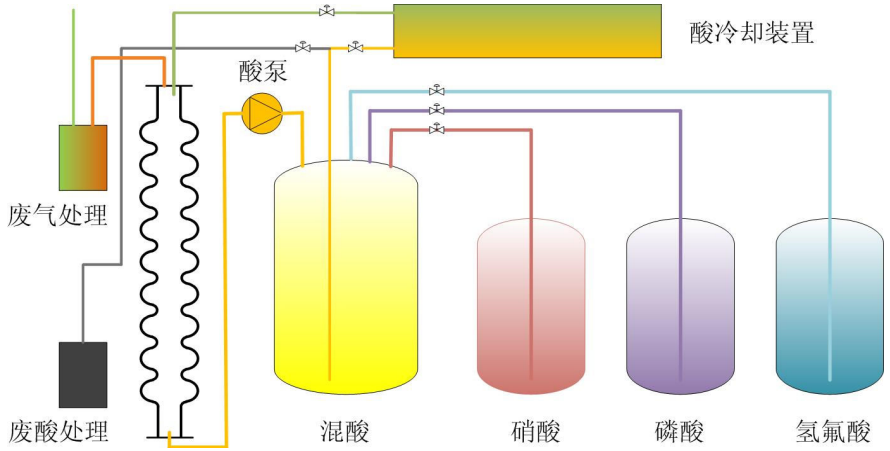


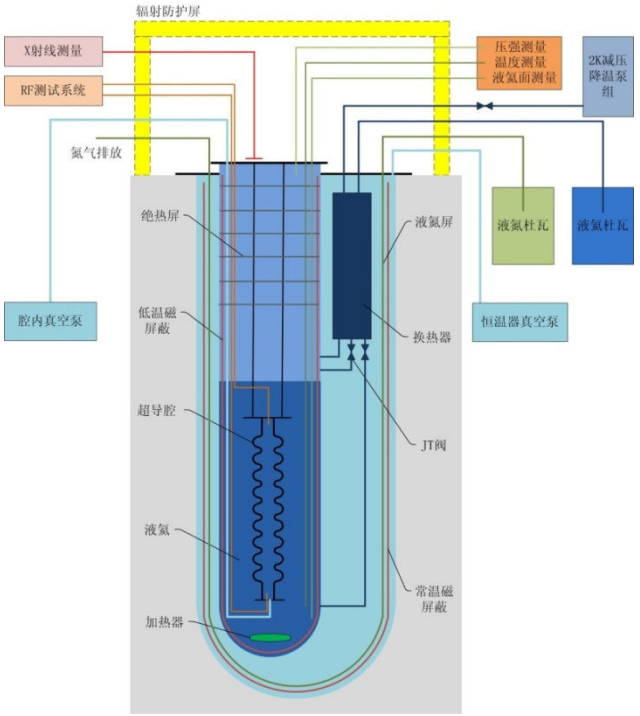
Cryo-modules



Future Plan

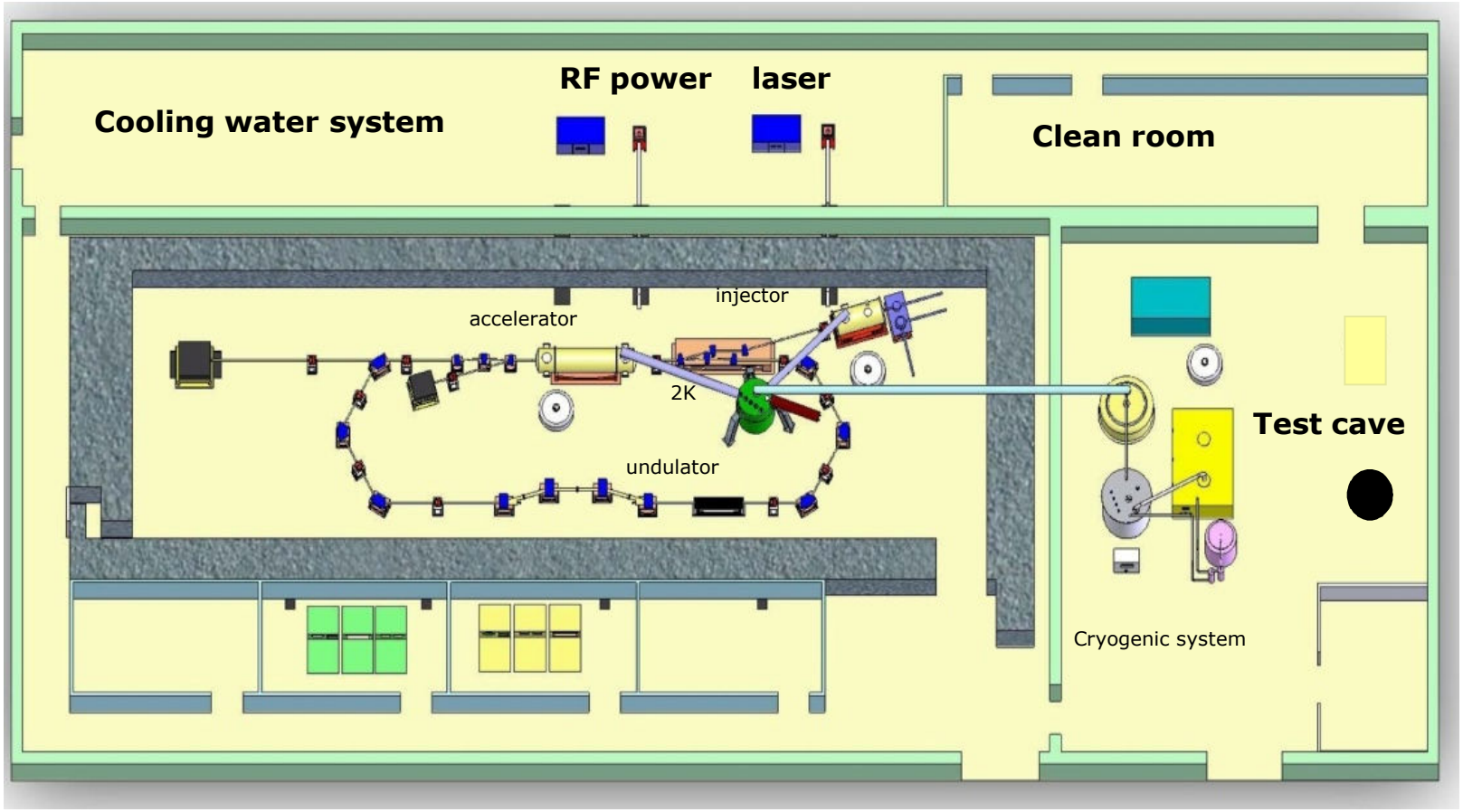
- **BCP system for 9-cell cavity and vertical test system will be built**





Future Plan

A “well” with 5m depth and 1.3m diameter is ready



Future Plan

First 2K cryogenic system for SRF in China

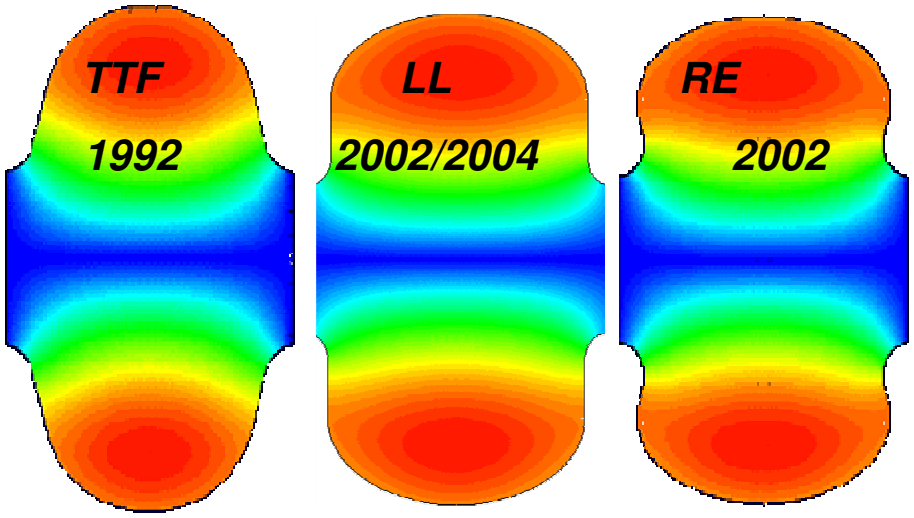
Future plan

More 9-cell cavities will be fabricated with higher Eacc!

Thank you!

Pretest processing of 9-cell cavity

- BCP , ~ 100 μm
- 600°C , 10 hrs
- Field flatness tuning
- BCP , ~50 μm
- HPR , ~ 5 hrs
- BCP , ~50 μm



r_{iris}	[mm]	35	30	33
k_{cc}	[%]	1.9	1.52	1.8
E_{peak}/E_{acc}	-	1.98	2.36	2.21
B_{peak}/E_{acc}	**[mT/(MV/m)]**	**4.15**	**3.61**	**3.76**
R/Q	[Ω]	113.8	133.7	126.8
G	[Ω]	271	284	277
R/Q*G	[Ω*Ω]	30840	37970	35123

Heat load (at 2K)

	Pulsed	CW
Static heat load of main accelerator	12 W	12 W
Dynamic heat load of main accelerator	4.4 W	88 W
Static heat load of injector	6 W	6 W
Dynamic heat load of injector	1 W	20 W
Transfer lines	10 W	10 W
Total heat load without contingency	33.4 W	136 W
Total static heat load with 50% contingency	42 W	42 W
Total heat load with 50% contingency	50.1 W	204 W (150L/h)

$$P_{diss} = \frac{V^2}{Q_0 \cdot R/Q} \times DutyFactor$$