



# RF superconducting Cavity R&D at Peking University

SRF Group

Institute of Heavy Ion Physics, Peking University

Linear Collider Workshop of the Americas  
March 19-23, 2011, Eugene, Oregon, USA



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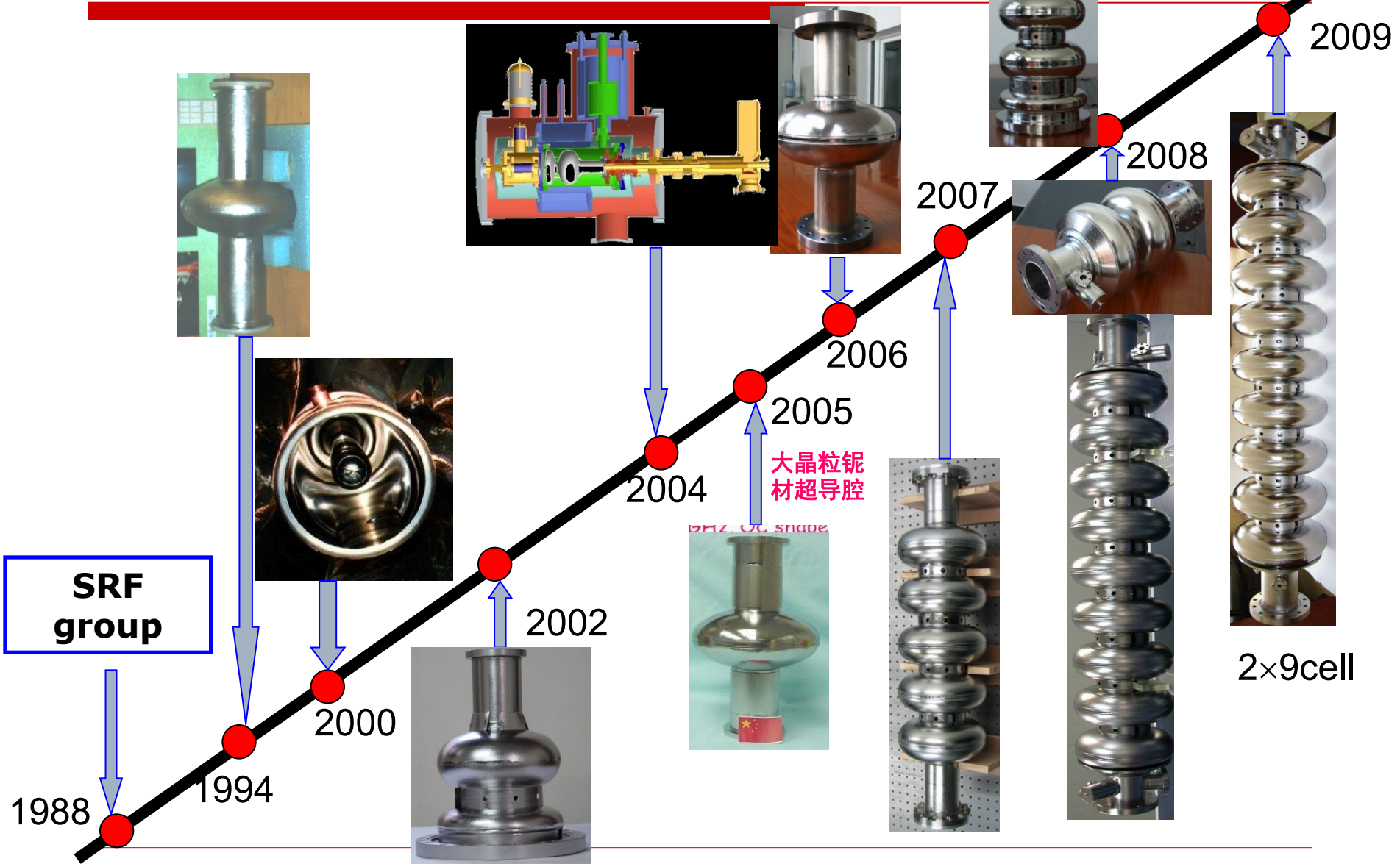
- **Cavities made by Peking University**
- **Development of related techniques**
- **Future plan**



## Cavities made by Peking University



# Development of SRF at PKU

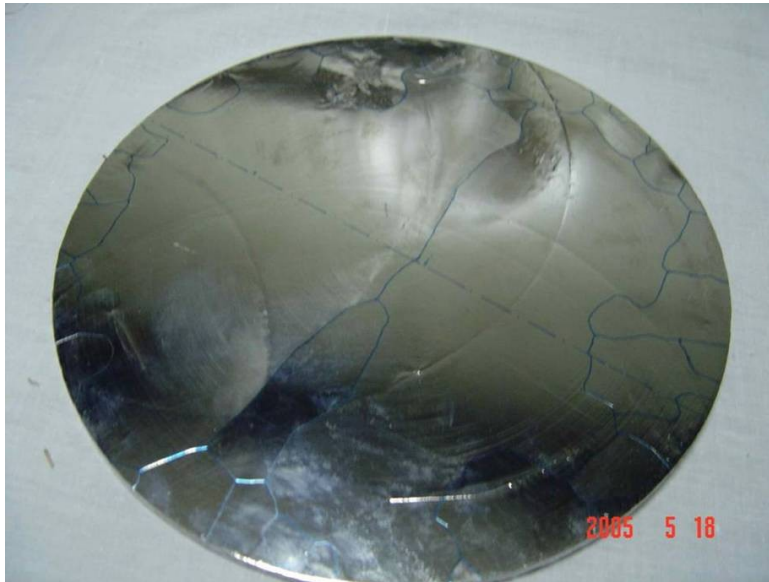


ALCPG2011, 3/19-23, 2011



## L-G Nb Cavities made by Peking University

Collaboration with OTIC to develop Large Grain Nb cavity since 2005

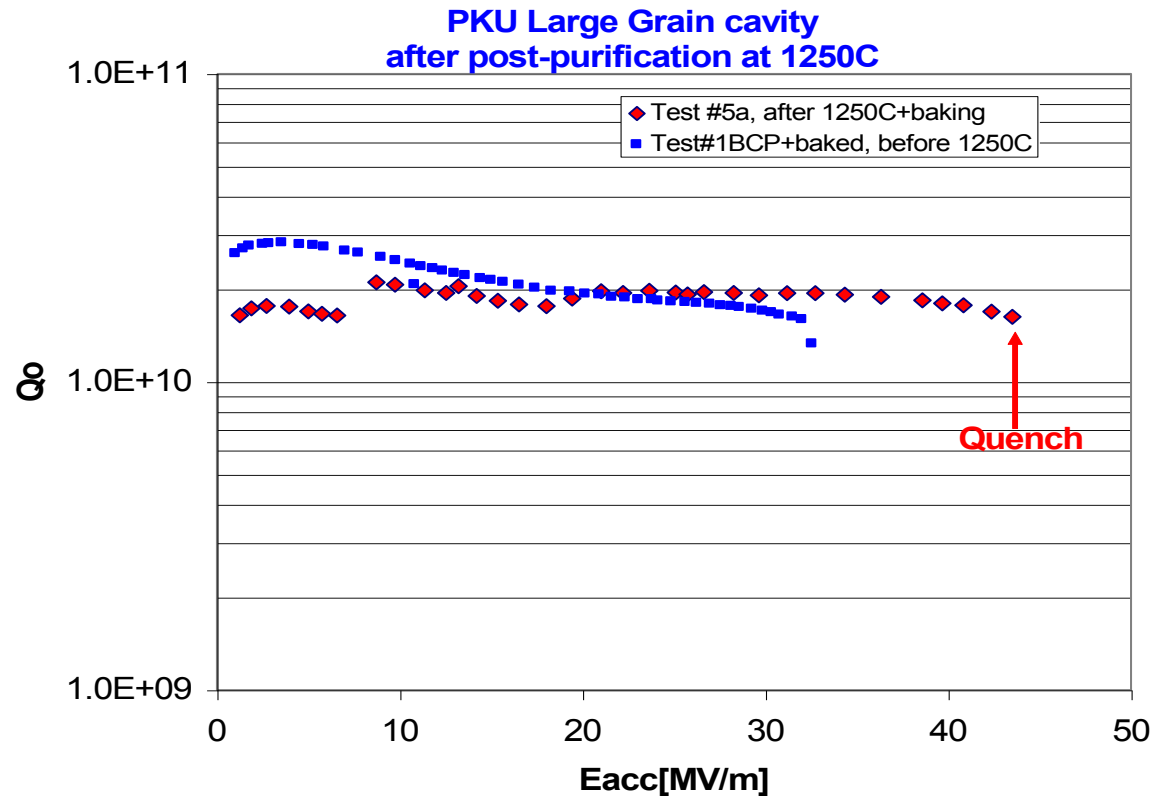


- Simplify the machine process of Nb sheets
- Only BCP is needed



# 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

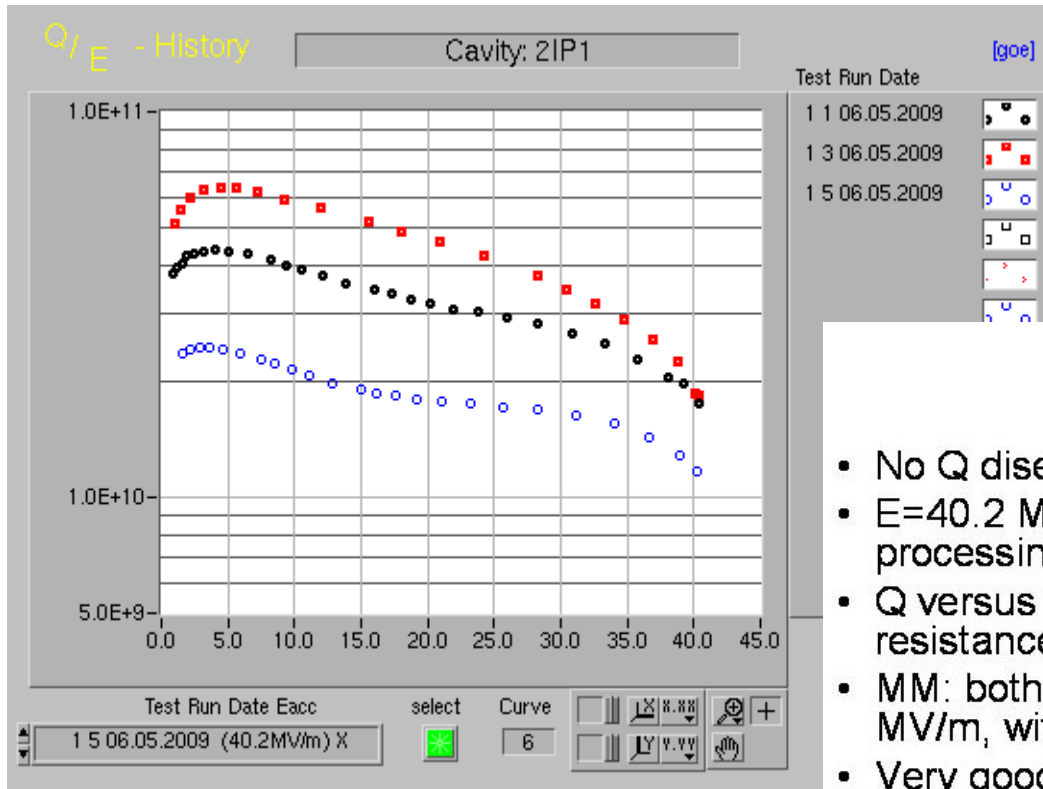


After BCP treatment & baking at 120°C for 12 hrs by Dr. P. Kneisel at J-Lab



# L-G Nb Cavities made by Peking University

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



## Conclusions:

- No Q disease.
- $E=40.2$  MV/m,  $Q=1.2 \cdot 10^{10}$ , 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.

After 80  $\mu$ m BCP, HT 800°C, 100  $\mu$ m EP, 4 x HPR, HT 120°C in Ar atmosphere, kept at 90-140 K for 24 hours

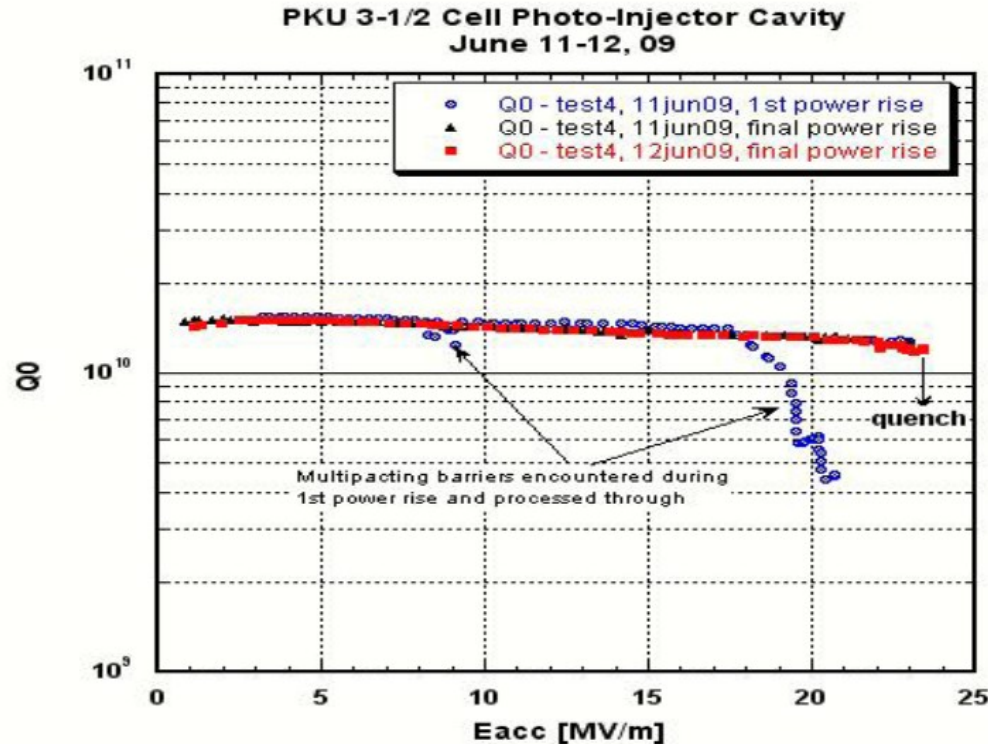
Vertical test at DESY

Krzysztof Twarowski



# L-G Nb Cavities made by Peking University

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



Vetical test at JLab

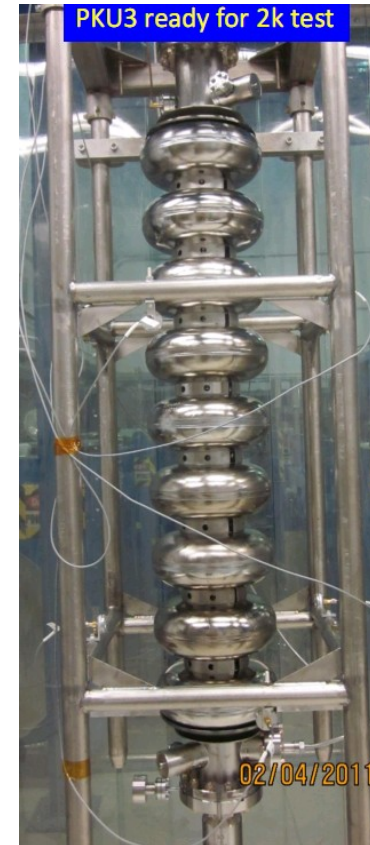
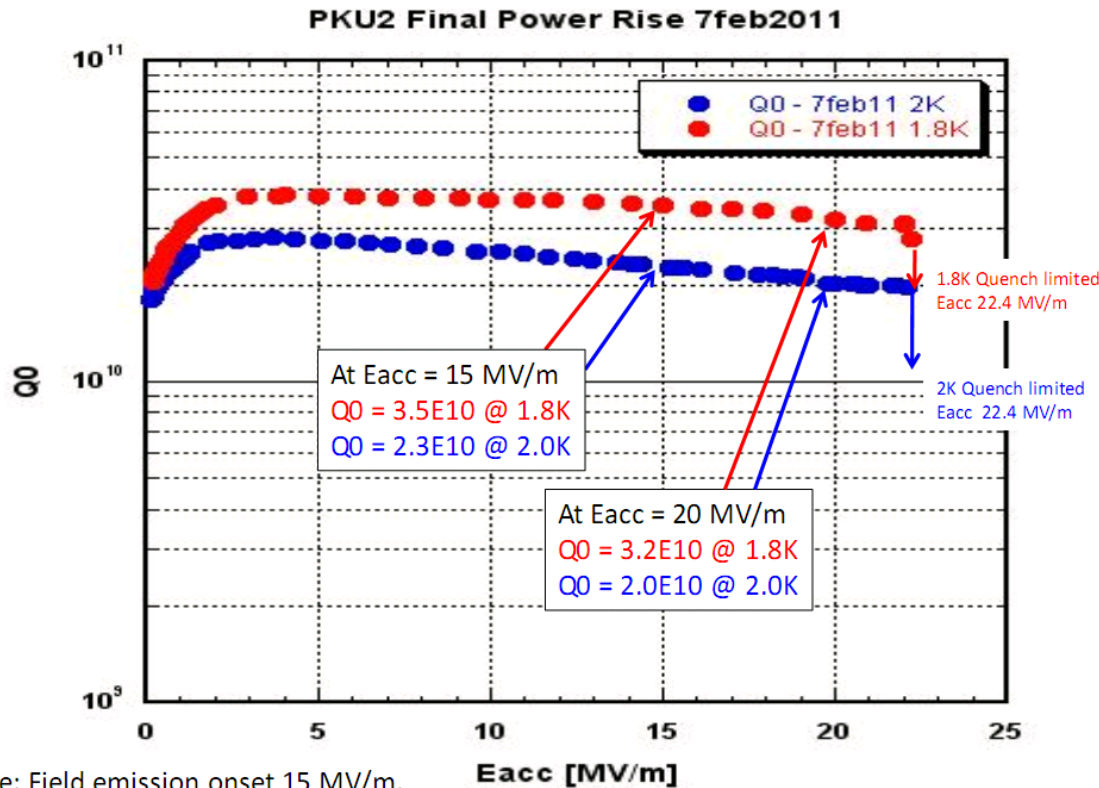
Large grain 3.5 cell Nb cavity of 23.5 MV/m @  $Q_0 > 1E10$  after BCP, HPR and HT 2 hrs at 800°C by Dr. R. Geng at J-Lab





# L-G Nb Cavities made by Peking University

**LG 9-cell (PKU-2) cavity, Eacc is 22.5MV/m, BCP+EP+120Cx48hr bake. Achieved a very high  $Q_0$**



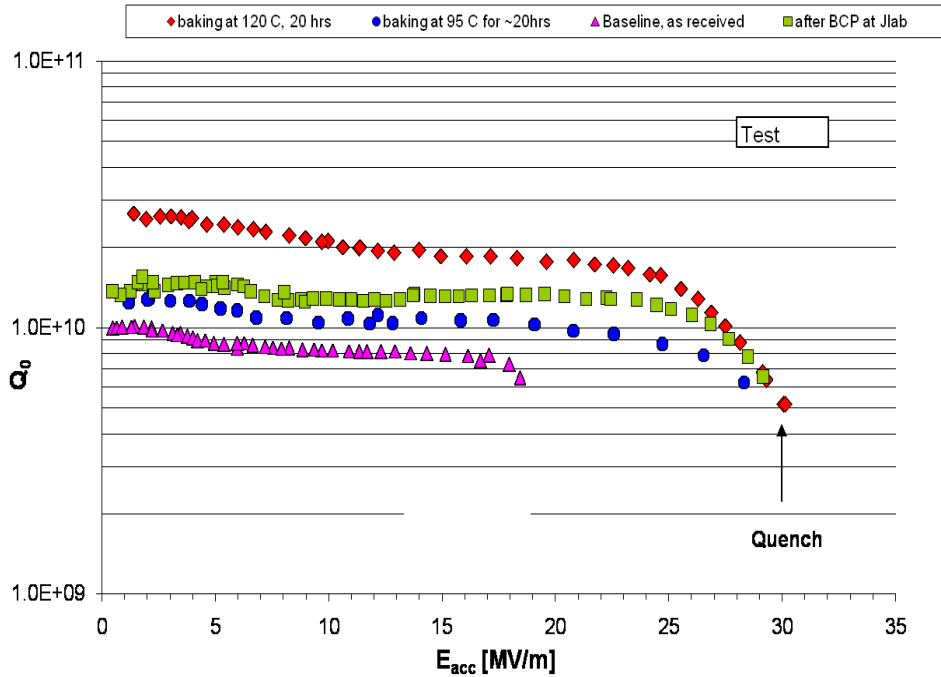
Note: Field emission onset 15 MV/m,  
Maximum X-ray dose rate < 100 mR/m. No more mode mixing observed during final power rise.

**Vertical test at JLab**



# F-G Nb Cavities made by Peking University

## 2-Cell PKU Cavity, Ningxia Niobium



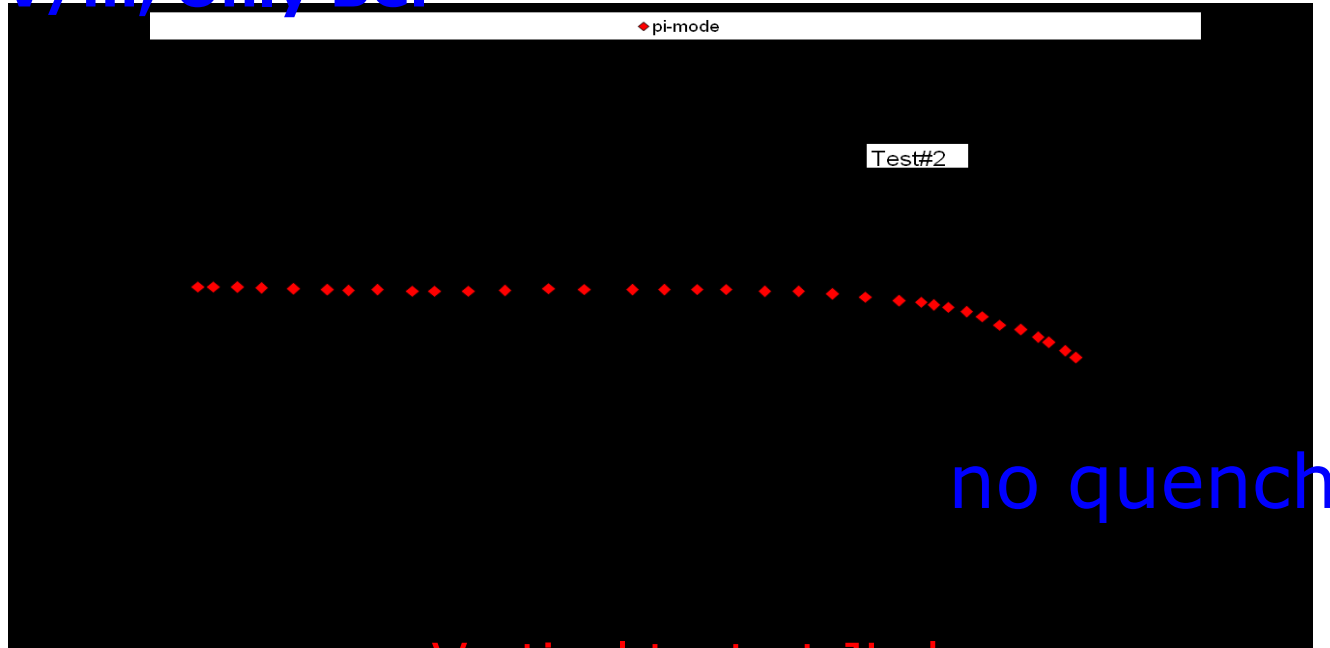
Fine grain Nb cavity

Treated & Tested by Dr. P Kneisel at JLab



# F-G Nb Cavities made by Peking University

**In 2008, first 9-cell (PKU-1) cavity in China, Eacc is 23MV/m, Only BCP**



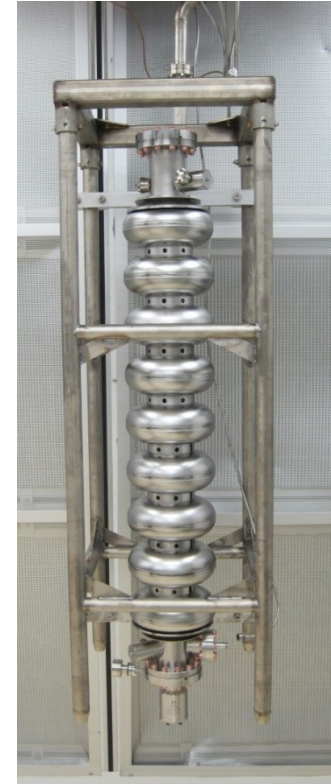
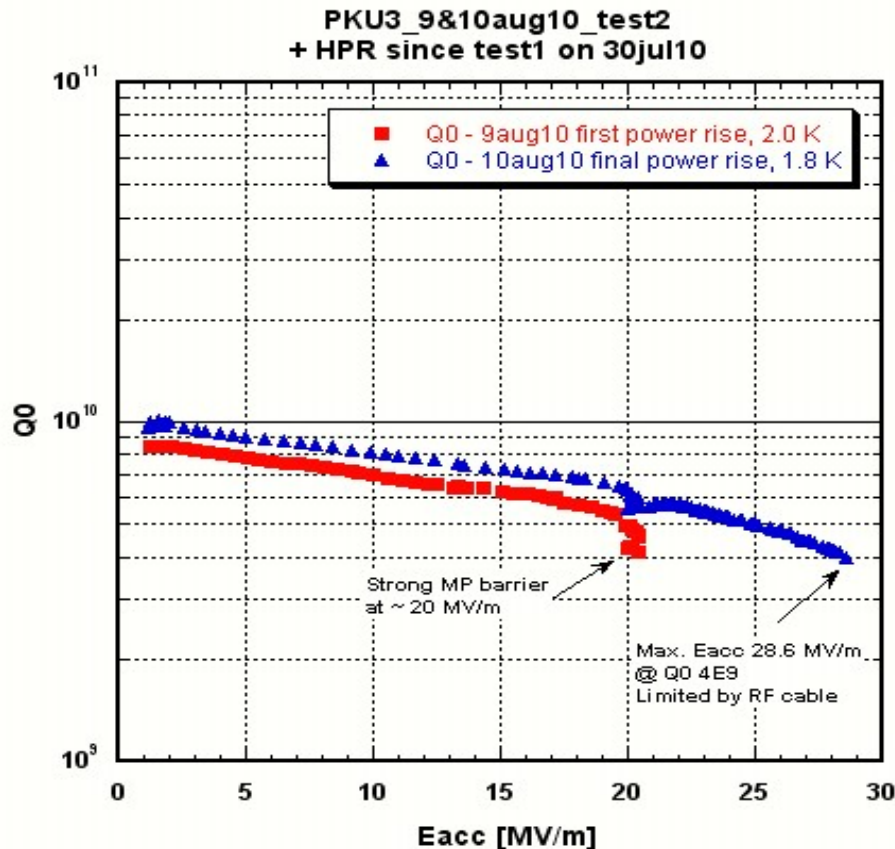
Vertical test at JLab





# F-G Nb Cavities made by Peking University

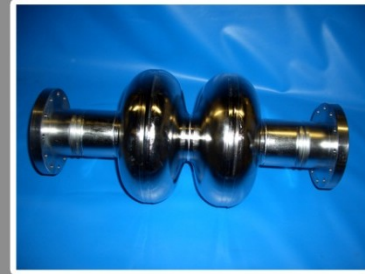
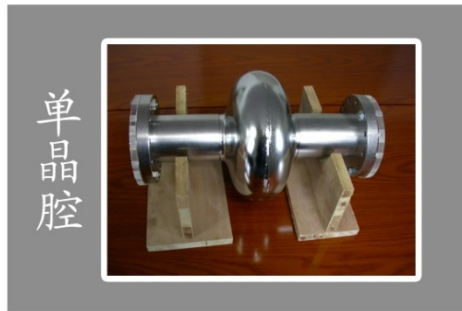
**Cavity PKU-3, Eacc is 28.6MV/m, EP, first 9-cell cavity with end groups in China reaching a gradient usable for the ILC**



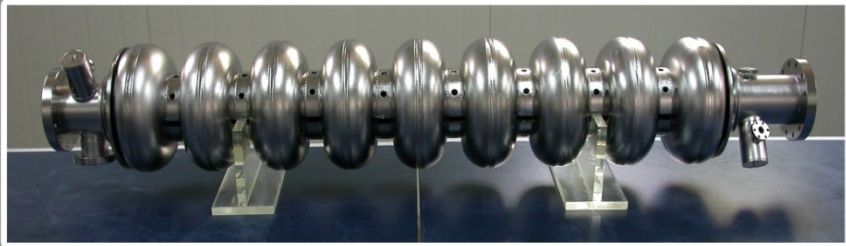
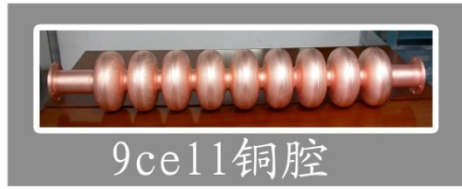
Vertical test at JLab



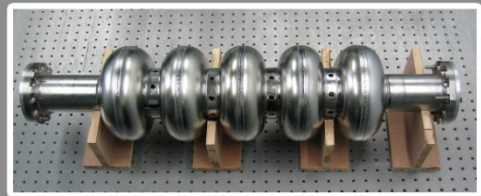
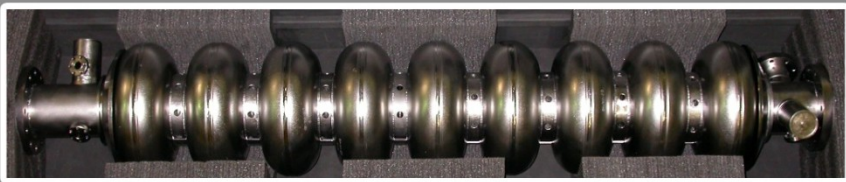
# 10 Cavities totally, 6 with end group



大晶腔系列



细晶腔系列



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



## Development of Related Techniques for Cavity



# Development of Relative Techniques for Cavity

## Deep drawing and machining of cups



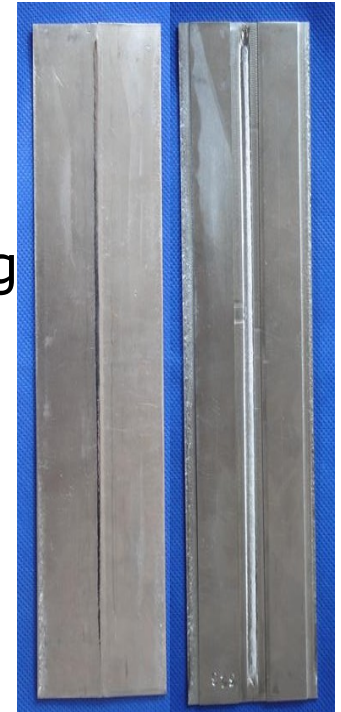


# Development of Relative Techniques for Cavity

## 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



Geometrical test

## RF test and tuning of cups and dumb-bells



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



Measure the frequency of cups



# Development of Relative Techniques for Cavity

## Processing of Nb dumbbells



Cleaning



BCP Polishing



Anode oxidizing

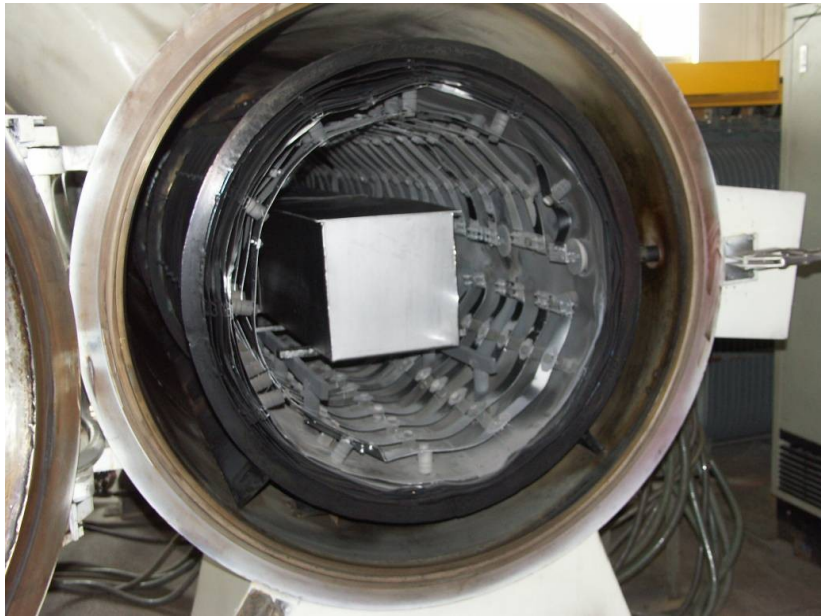


Defect detection



# Development of Relative Techniques for Cavity

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





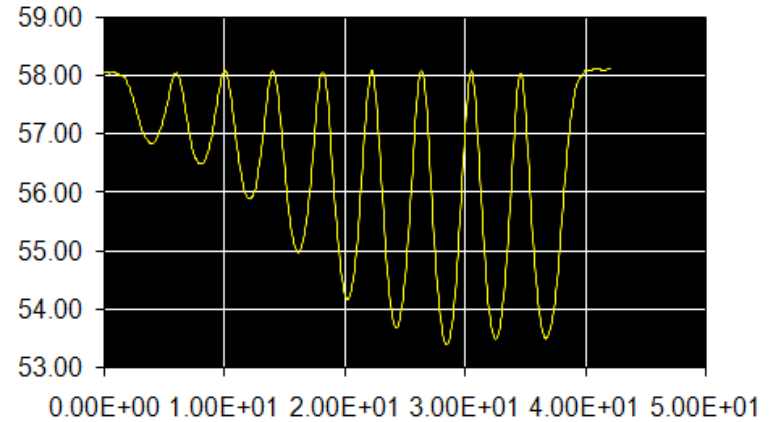
# Development of Relative Techniques for Cavity

## Tuning for 9-cell cavity

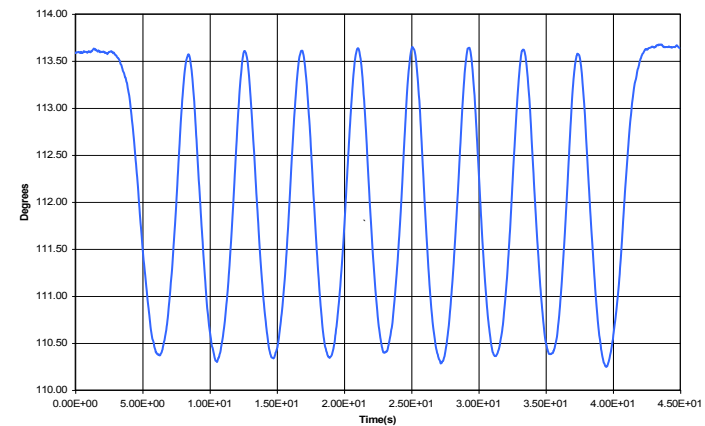


SRF cavity tuning facility

Before Tuning



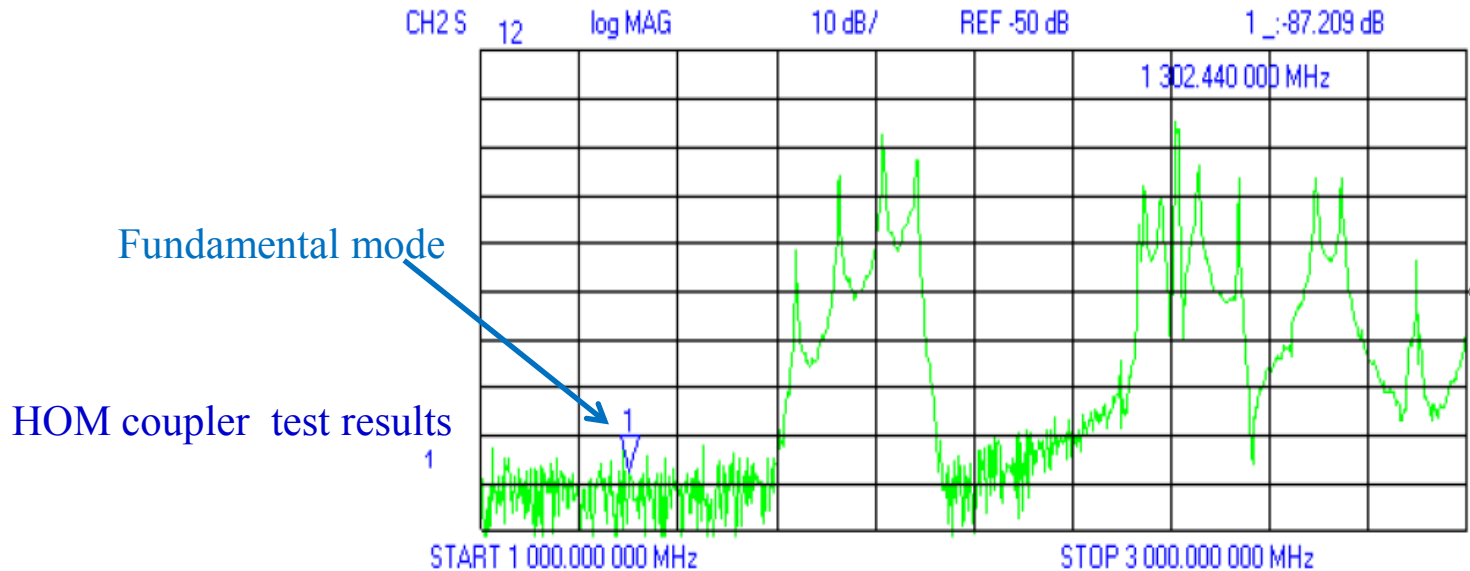
After Tuning





# Development of Relative Techniques for Cavity

## HOM coupler





## Future Plan



## Future plan

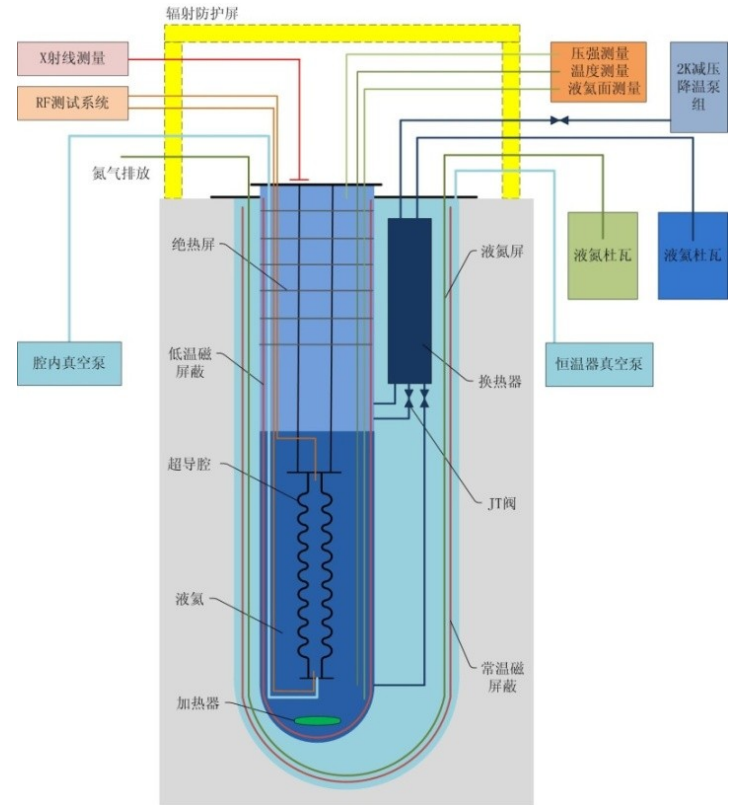
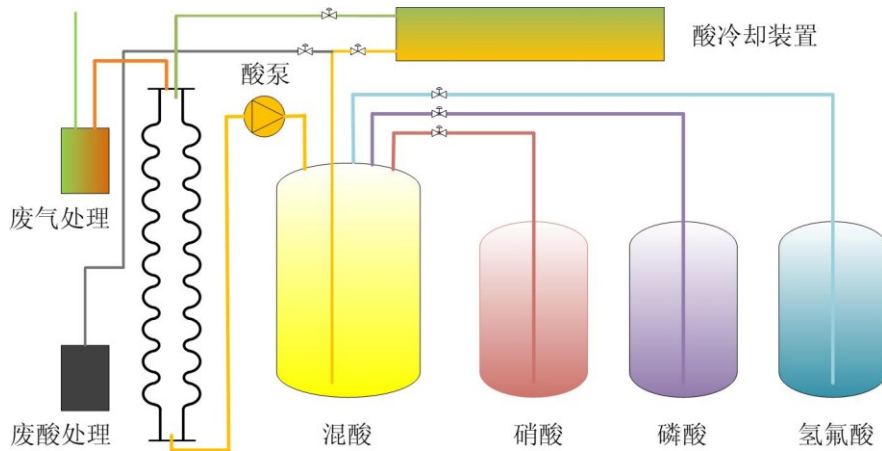
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- To realize industrialization of RF superconducting cavity, a joint-stock company--Ningxia Orient Superconductor Technology Co., Ltd. was set up on Feb. 28, 2011 under the cooperation between OTIC and Peking University.
- Ningxia Orient Superconductor Technology Co., Ltd. will mainly develop cavity fabrication technology from material to EB welding.
- Two 7-cell cavities and two large grain 9-cell cavities will be made this year.



# Future Plan

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

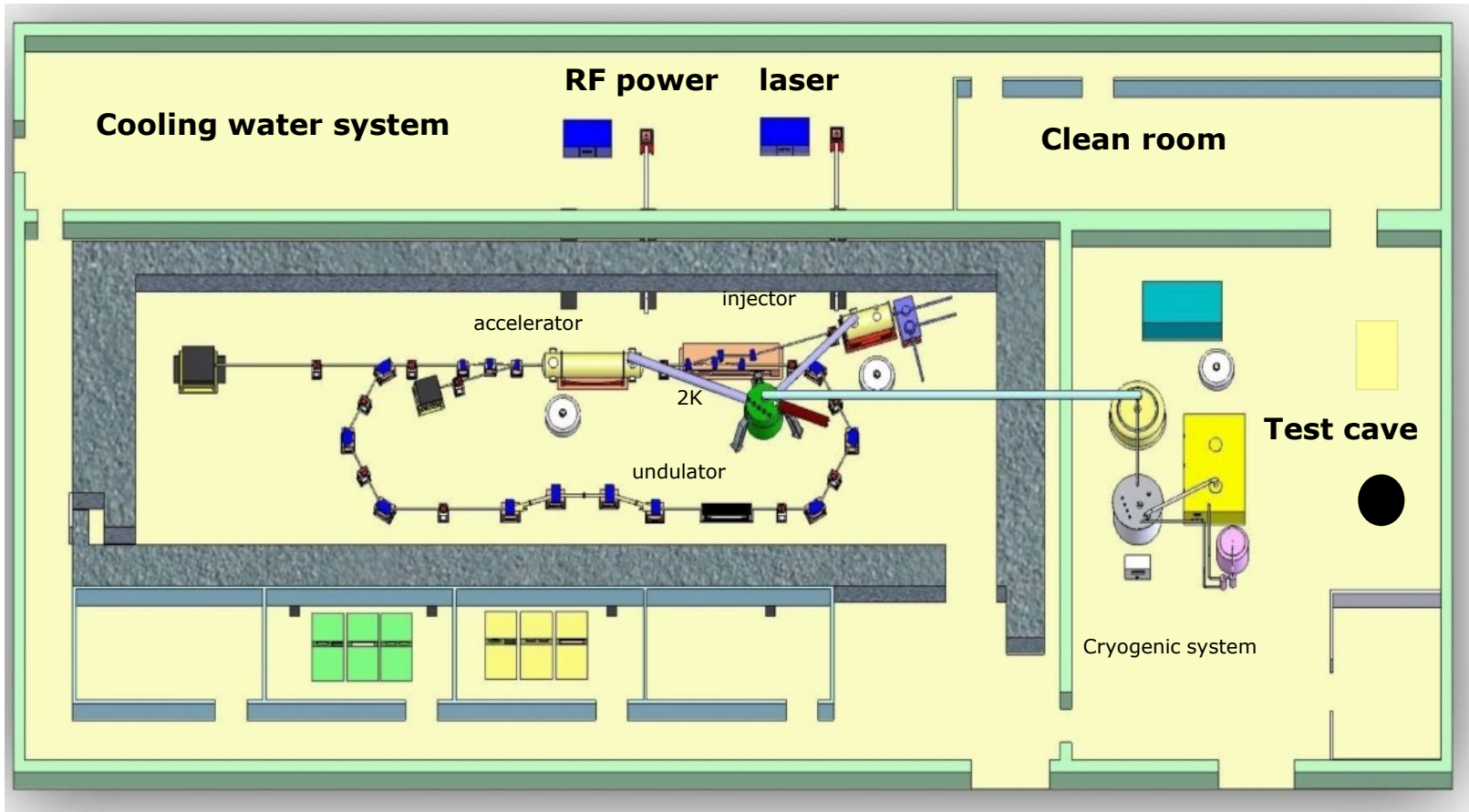






# Future Plan

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





## Future Plan



First 2K cryogenic system for SRF in China.  
Two more pumps are needed for vertical test system.





**Thank you  
for your attention!**