Progresses on 9-cell cavities at Peking University

SRF Laboratory, PKU

June 4, 2007

Introduction

- SRF group of PKU started to design and fabricate TESLA type 9-cell SC cavities at the end of 2006 .
- Collaborators: Ningxia OTIC & Harbin Institute of Technology
- Team advisor: Prof. Dr. Proch (DESY)
- Experts from DESY and Jlab have given many supports and help.

Goals of the first step

- Technique experiment on 9-cell copper cavity: end of June 2007.
- EB welding, tuning and post treatments of 5-cell niobium cavity: end of July 2007.
- Finish the first 9-cell niobium cavity: end of Sep. 2007.

- 9-cell copper cavity
  - Qualification of dies of deep drawing
  - Cups trimming technology
  - Test of EBW tools
  - Cavity measurement and pre-tuning
- 5 cell Nb cavity
  - Modification of EBW tools if needed
  - BCP polishing, HPR, etc.
  - EBW technology of multi-cell Nb cavity
- 9-cell Nb cavity (without HOM group)
  - EBW technology of 9-cell Nb cavity
  - BCP polishing, HPR, etc.

Organization

(3 main working groups)

WG1. Deep drawing and machining:

Baocheng ZHANG, Zhenchao LIU

WG2. Welding and post processing:

Xiangyang LU, Jiankui HAO

WG3. Tuning and RF experiments:

Shengwen QUAN, Wencan XU

Totally ~ 30 colleagues take part in the research:

- 15 scientists and engineers
- 15 graduate students.

Part I
Deep drawing and machining

Deep drawing and machining of cups for 9-cell Cu cavity are finished.

Deep drawing and machining of cups for 5-cell Nb cavity are finished.

Cu Cups

9 cell Resonator Control Criterion

Name: Mid Cup			**Drawing No:** 1—020—01					**Machine No:** M16			
Parameters	Control Criterion		Value (/45°)								
			1	2	3	4	5	6	7	8	
	Inner Equator/mm	$\phi 206.9^{+0.2}_{+0.1}$	207.0	207.09	207.0	207.02					
	Equator Thickness/mm	1.7 ± 0.05	1.8	1.8	1.8	1.8	1.8	1.8	1.79	1.79	
	Inner Iris/mm	$\phi 70.1^{+0.2}_{+0.1}$	70.11	70.12	70.12	70.1					
	Iris Thickness/mm	2 ± 0.05	2.01	2.01	2.02	2.02	2.03	2.03	2.04	2.04	
	Inner S. Ring/mm	$\phi 107_{-0.05}$	106.9	106.92	106.92	106.93					
	S. Ring Cut Depth/mm	$0.65^{+0.1}$									
	Parallel (Eq.&Iris)/mm	$// 0.02$	0.00	0.04	0.045	0.08	0.1	0.08	0.04	0.01	
	S. Ring Cut Smoothness	$\nabla 7$, No burr				Conclusion:					
	Seam Smooth-ness Eq.	$\nabla 7$, No burr				Conclusion:					
	Seam Smooth-ness Iris	$\nabla 7$, No burr				Conclusion:					

Machine Date: _____ Sign: _____

Check-up Date: _____ Sign: _____

Nb Cups

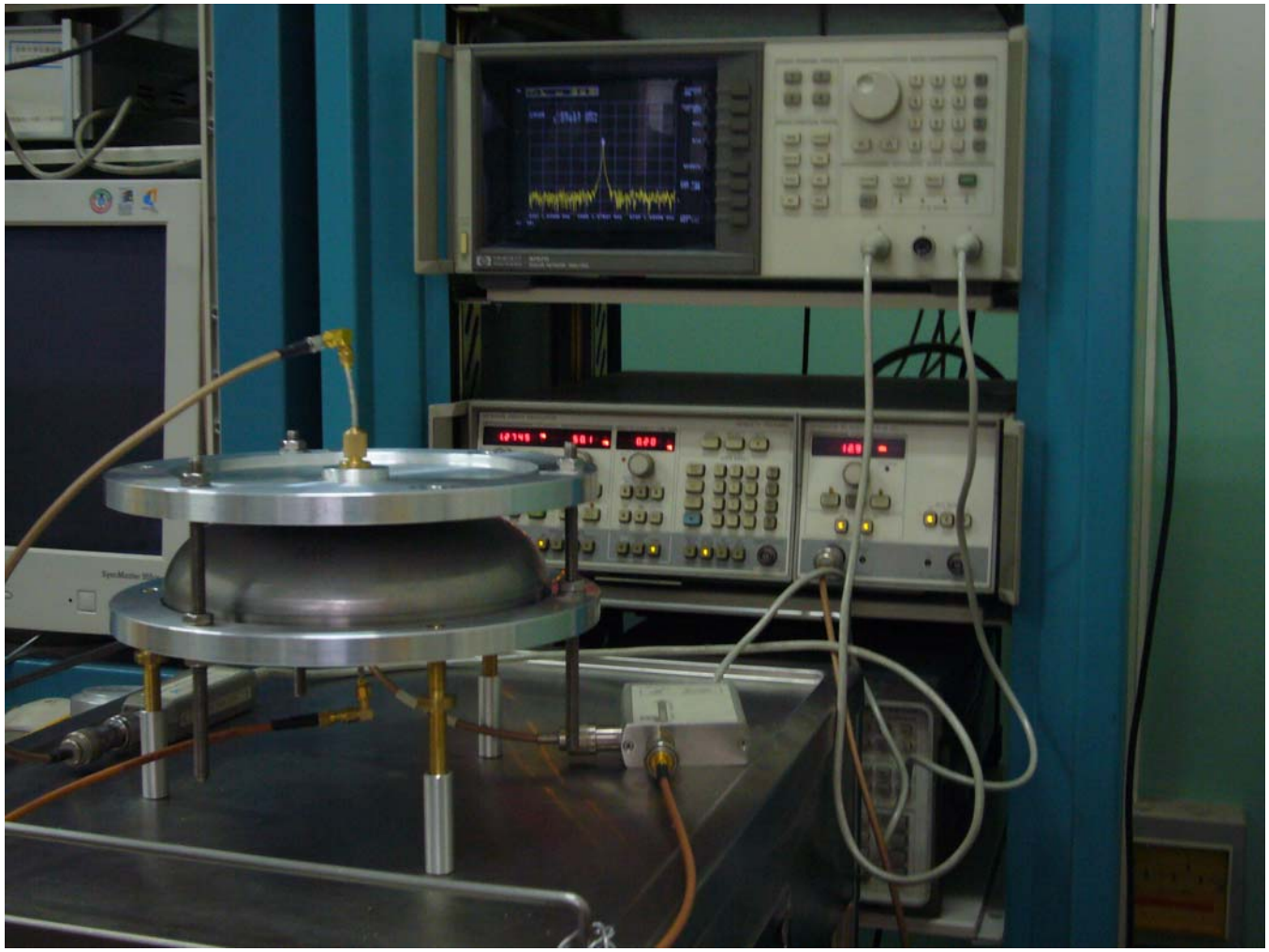
9 cell Resonator Control Criterion

Name: Short End Group Cup			**Drawing No:** 1—030—01					**Machine No:** S			
Parameters	Control Criterion		Value (/45°)								
			1	2	3	4	5	6	7	8	
	Inner Equator/mm	$\phi 206.9^{+0.1}_{-0.2}$	206.8	206.98	206.92	206.8					
	Equator Thickness/mm	1.7 ± 0.05	1.7	1.7	1.7	1.7	1.7	1.72	1.72	1.7	
	Inner Iris/mm	$\phi 78.1^{+0.2}_{+0.1}$	78.3	78.3	78.3	78.3					
	Iris Thickness/mm	2 ± 0.05	2.04	2.04	2.04	2.08	2.08	2.06	2.06	2.06	
	Inner S. Ring/mm	$\phi 107_{-0.05}$	106.98	106.92	106.9	106.94					
	S. Ring Cut Depth/mm	$0.65^{+0.1}$									
	Parallel (Eq.&Iris)/mm	$// 0.02$	58.31	58.28	58.33	58.35	58.34	58.32	58.32	58.35	
	S. Ring Cut Smoothness	$\nabla 7$, No burr				Conclusion:					
	Seam Smooth-ness Eq.	$\nabla 7$, No burr				Conclusion:					
	Seam Smooth-ness Iris	$\nabla 7$, No burr				Conclusion:					

Machine Date: May 18, 2007 Sign: _____

Check-up Date: May 19, 2007 Sign: _____

Frequency Measurement



9-cell Nb cavity

- The qualified Nb sheets and other materials for 9-cell Nb cavity from Ningxiang were deliverd to PKU

- The cups of 9 cell Nb cavity will be formed according to schedule

Part II
EBW and Post Processing

The cavity EBW will be performed at HIT (Harbin Institute of Technology, Harbin)

The EBW sample test had done which include the RRR testes and the welding line figure control study.

The EBW line figures. Sample size: 133(L)×1.7(T)(right), 133×2 (m) and 266×1.7 (left)

Sample #	1	2	3	4	5	6	7	8	9
RRR	172	163	261	285	226	284	251	215	295

#1&2: vacuum is not good, ~1×10^{-4} Torr.

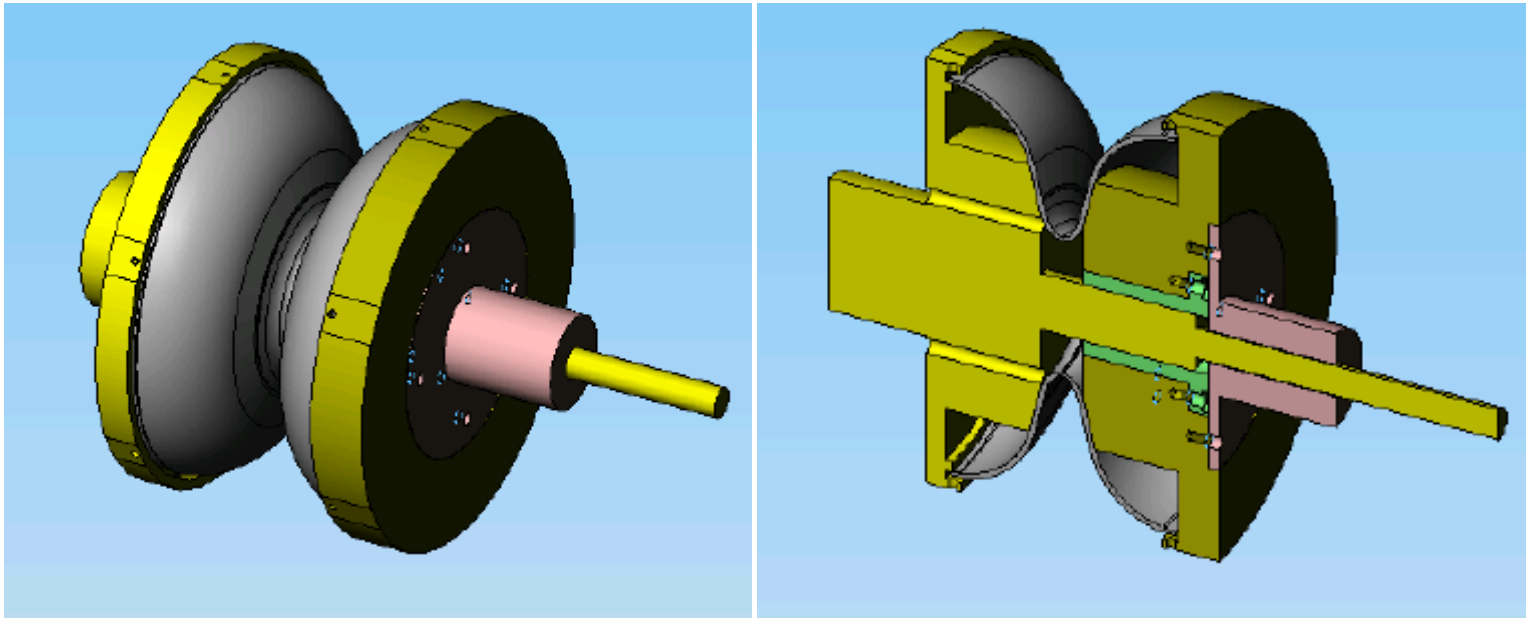
#3~9: 3.2-4.5 $\times10^{-5}$ Torr

Welding tools

- For dumbbells: finished
- For whole cavity: under discussion and will be finished soon

Welding of Dumbbells

- 1st step: welding from outside
- 2nd step: welding from inside



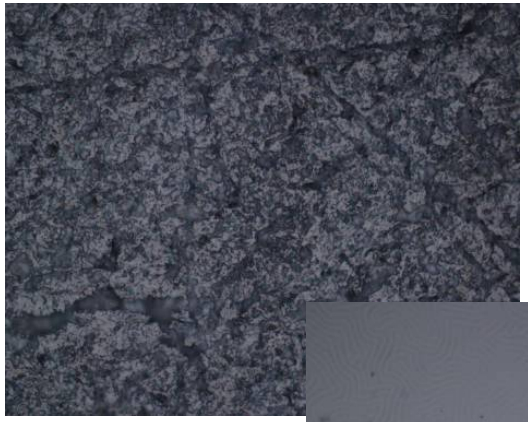
The Post Process Preparation

Chemical Process for Cups and Dumb bells

The Post Process Preparation

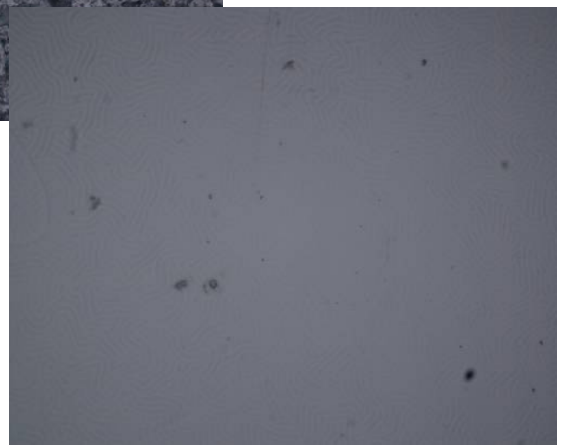
Chemical Process for Cups and Dumbbells

The primary BEP study



Mechanical Polishing

×1000



BEP

×1000

The clean room (class 100) for BCP and HPR for 9-cell cavities is under construction

2m^3 water tank

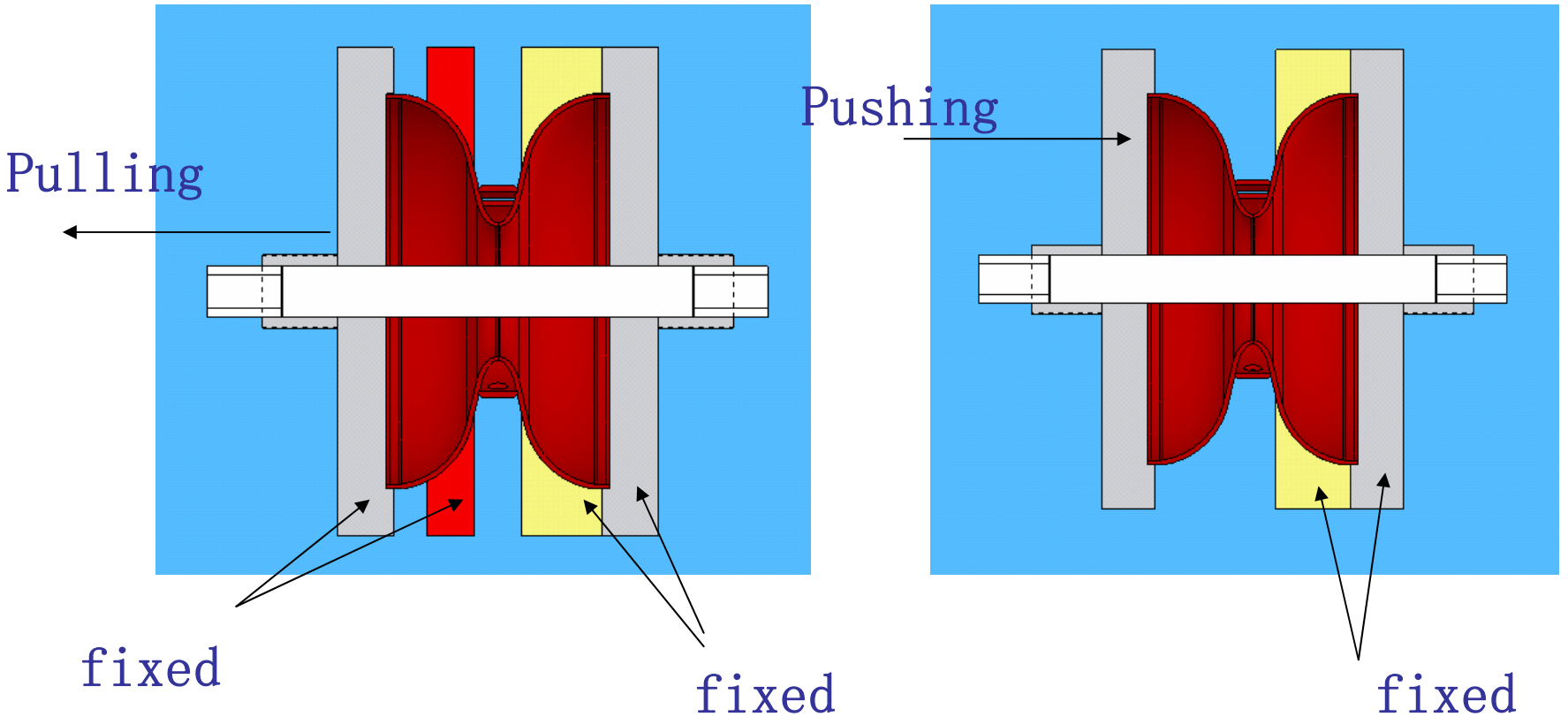
Part III
The progress of the auxiliary parts for 9cell TESLA cavity

Overview of recent progress

Many important auxiliary parts are going on being designed or fabricated:

1. The design of field flatness tuning for Dumb-bell, which may be the key tool for a whole cavity with correct frequency and length, has finished.
2. The design of field flatness tuning for 9 cell cavity is undergoing.
3. The low temperature experimental platform for tuner has been fabricated mostly.
4. Most of work about input coupler has been done,too .

Extending and Pressing of the dumb-bell

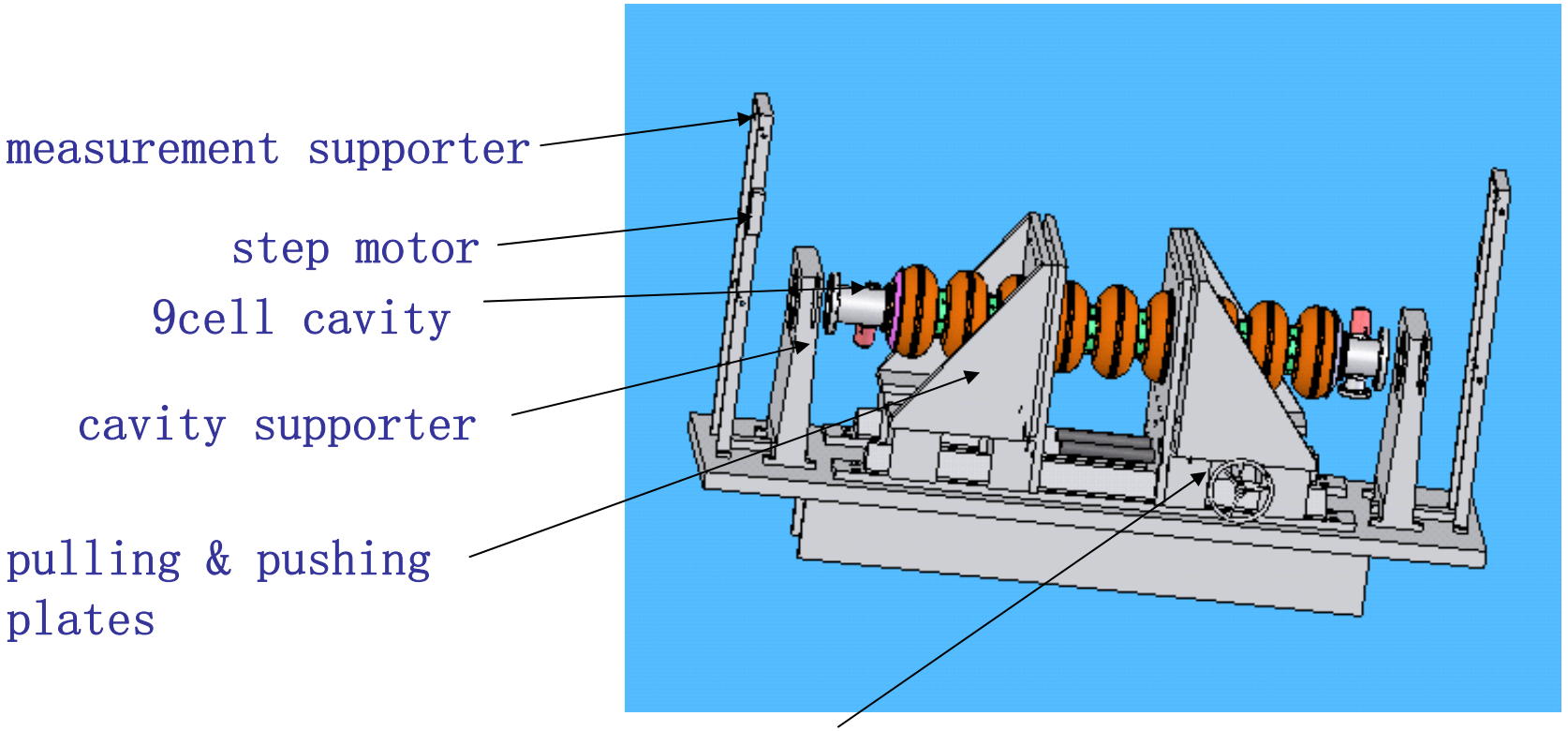


Extessing

Pressing

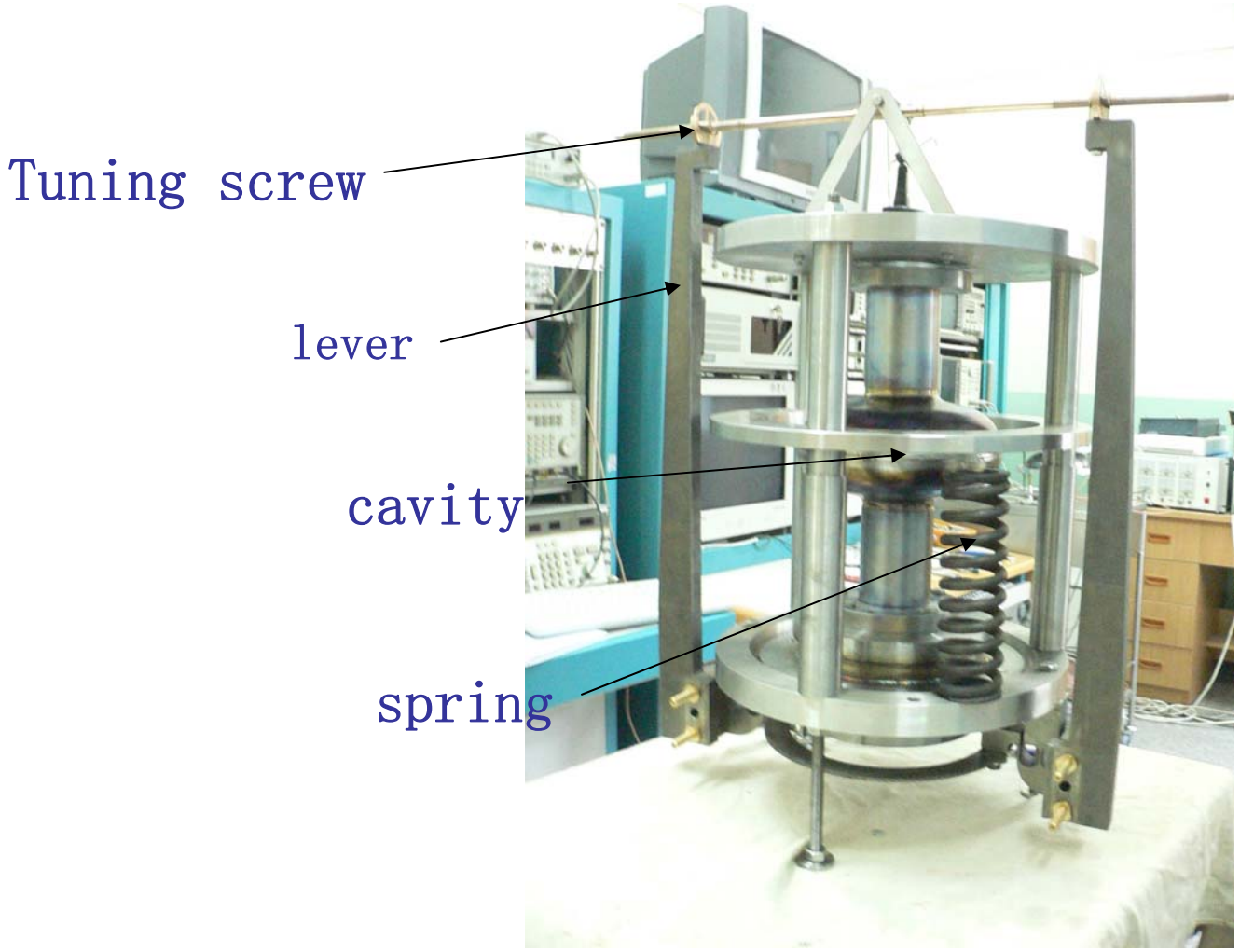
Field flatness tuning facility for 9cell cavity

- We designed the key components:The pulling and pushing plates and measurement system, including the automatic code.



Rotation motion transforming into longitudinal motion

Tuner experimental platform



Most of the components have been finished. We will do experiments in both room temperature and LN temperature.


Thanks