

# IHEP EP System Development

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9th KEK-IHEP Collaboration Meeting

Dec. 9th, 2020

# Outline

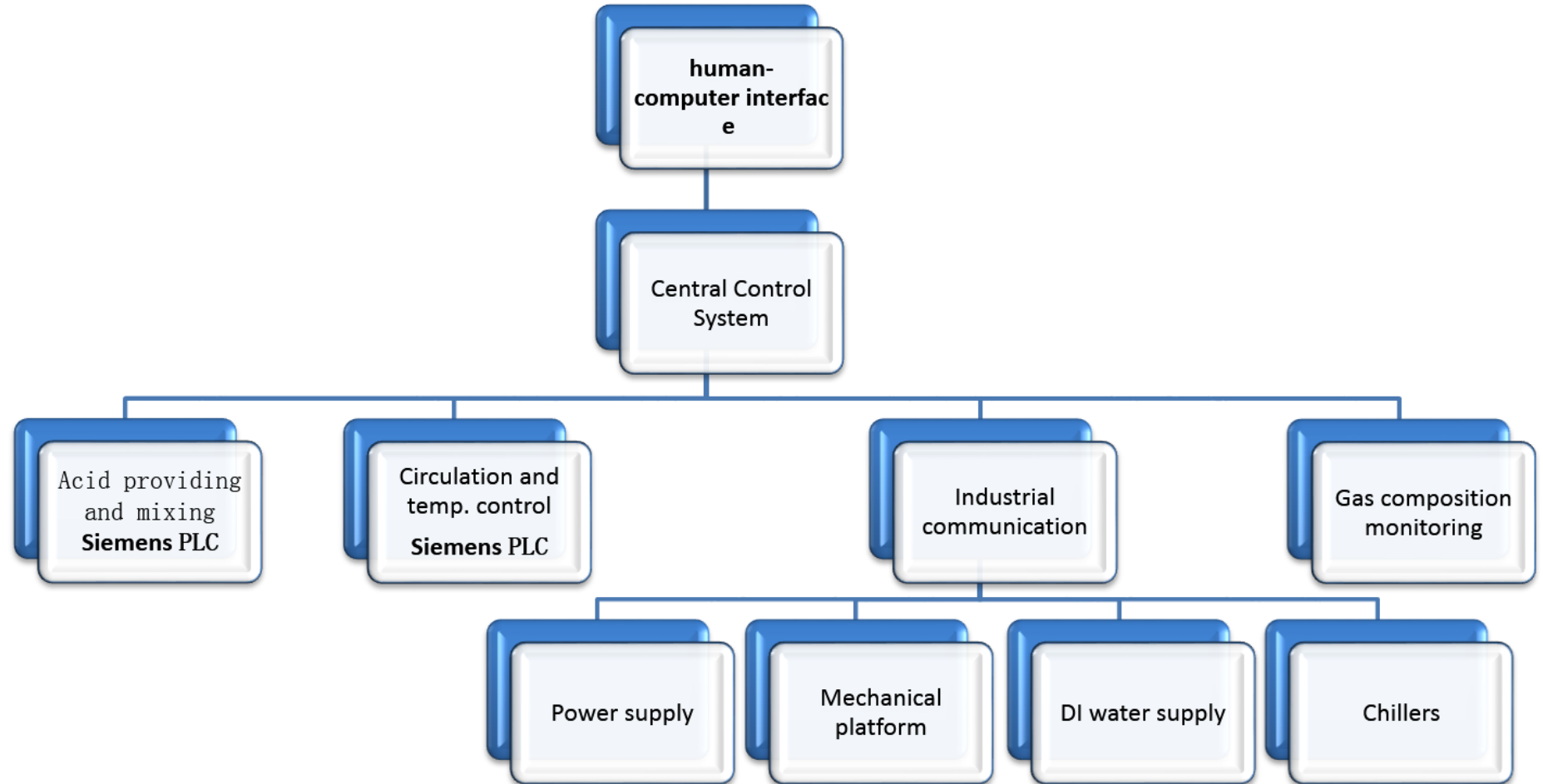
- Brief reminder of the system
- Main activities on the EP in last year
- Current status and next

# Brief reminder of IHEP EP history

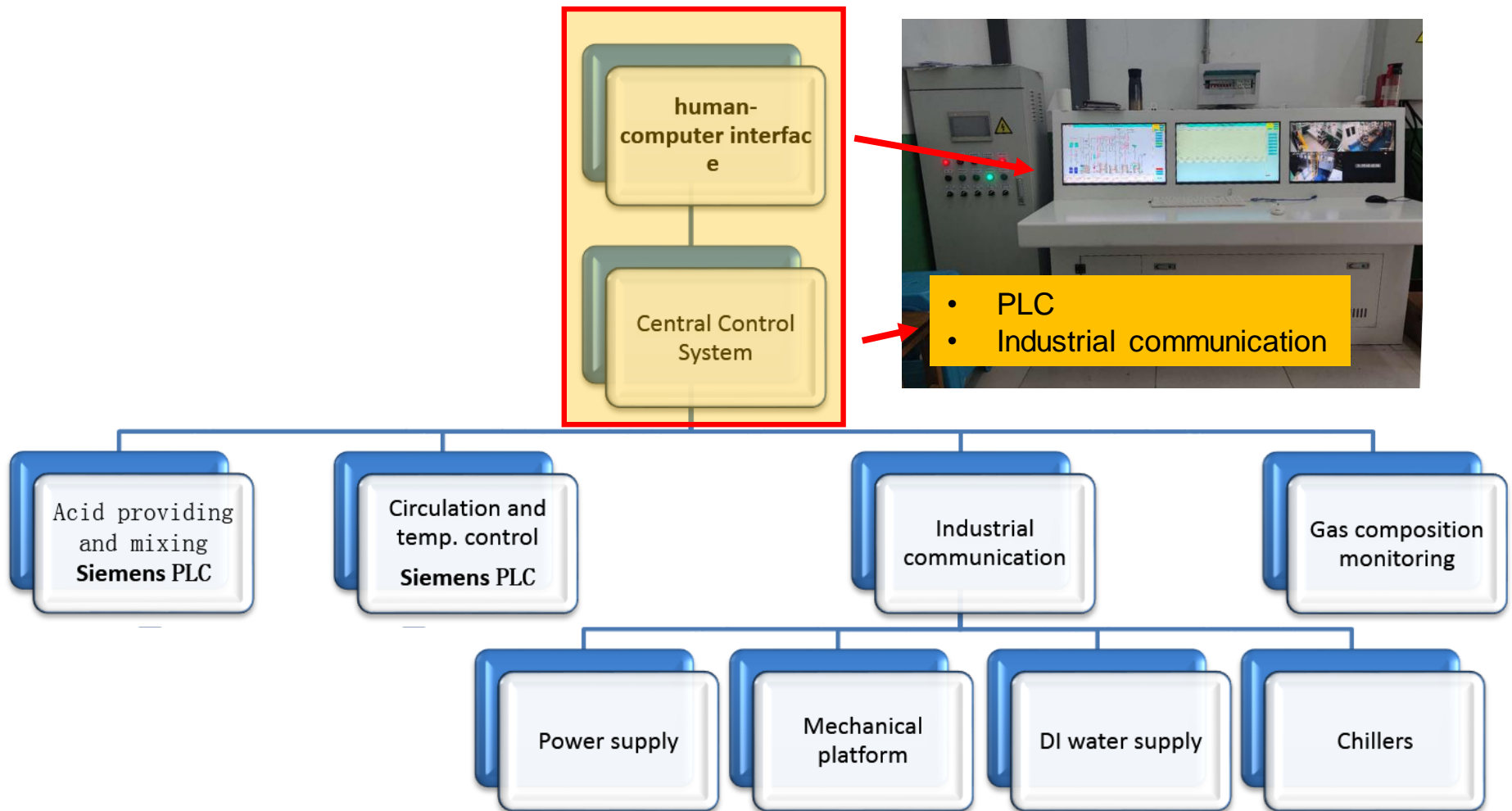
- 2016, conceived a IHEP EP system and made conceptual design
- 2017, finished Engineering design and started to fabricate components
  - May, 2017, useful discussion
  - June, 2017, 6th IHEP-KEK meeting decide people and information exchange
  - July, 2017, Funding available, and began to call for biddings
  - [people exchange to KEK later](#)
- June of 2018, components ready and followed water test
  - Sept. 2018, 7th IHEP-KEK meeting the discussion
- May, 2019, acid circulation for the first time at Ningxia company
  - A seminar was hold the our KEK experts
  - July, 2019, the system went into operation

*Many thanks to KEK colleagues in the collaboration.*

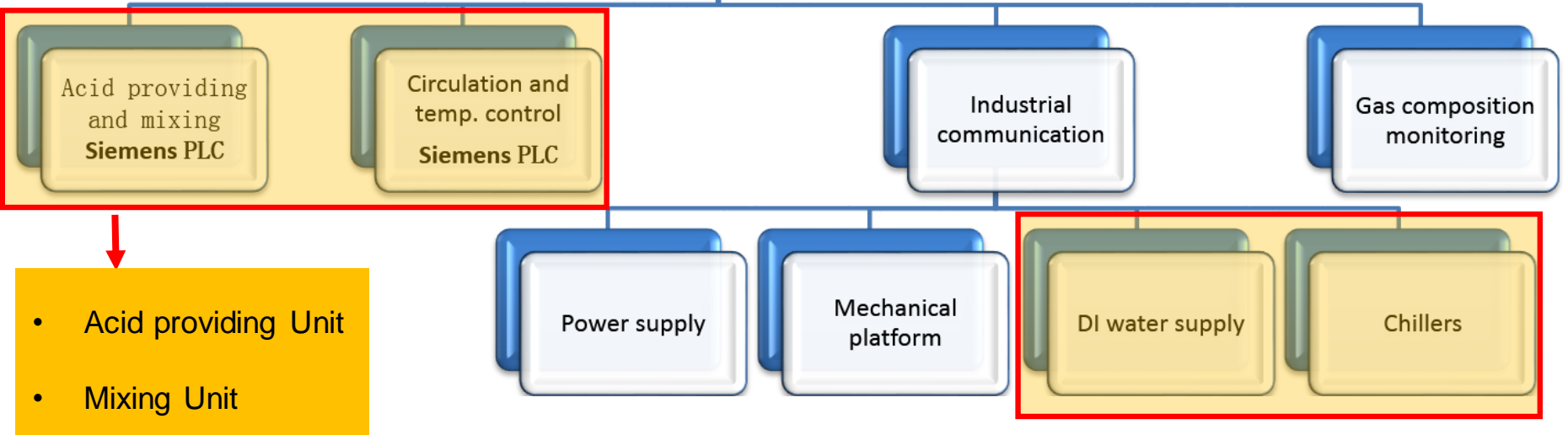
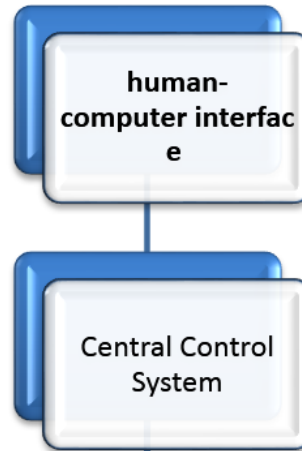
# Main units in the system



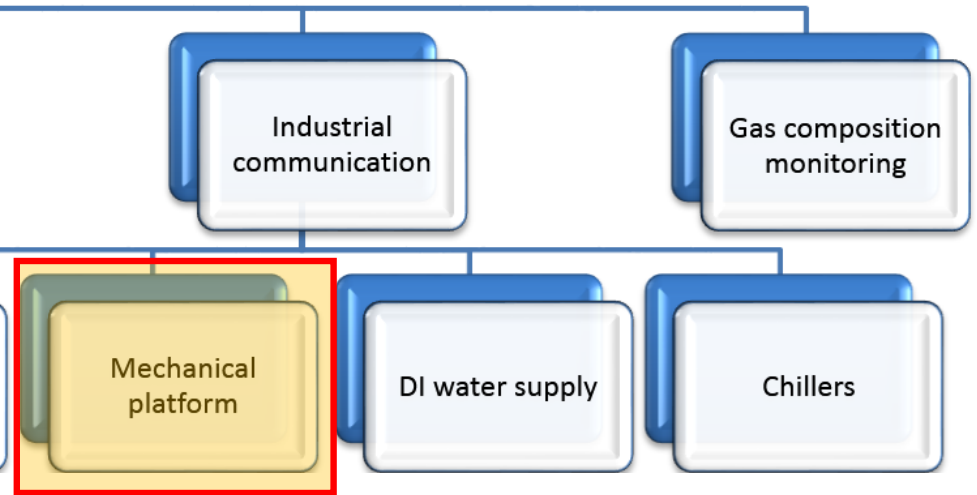
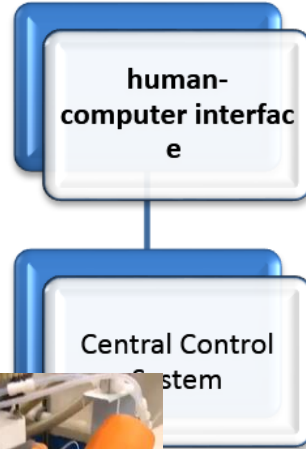
# Main units in the system



# Main units in the system



# Main units in the system



# Activities for EP system



# Main steps for running the machine

- Learning. All the things of the system are for the first time, like design, fabrication, assembly, commissioning, making procedure, operation....for **both IHEP and companies**.
- Understanding. In one hand, we need to understand the existing EP recipes; why some steps are done like in that way, and why parameters were set as that, and so on. And in other, we also need familiar with the machine.
- Trying. We make many trying to see whether those procedures or parameters could work in our system.
- Explore the recipe which can fit the IHEP EP system according to both EP running and vertical test results

# Main activities in last year

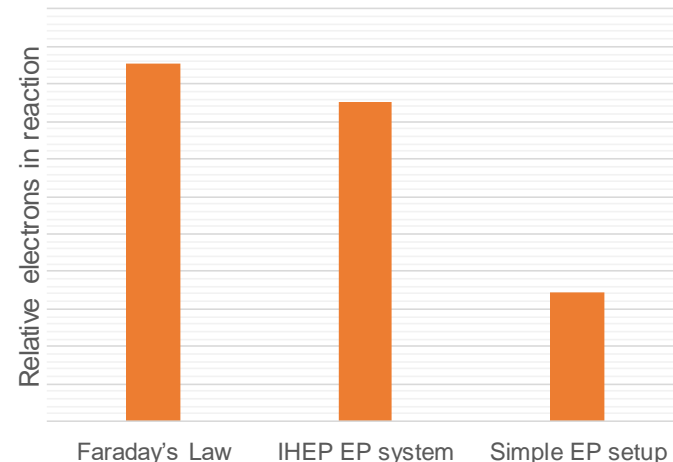
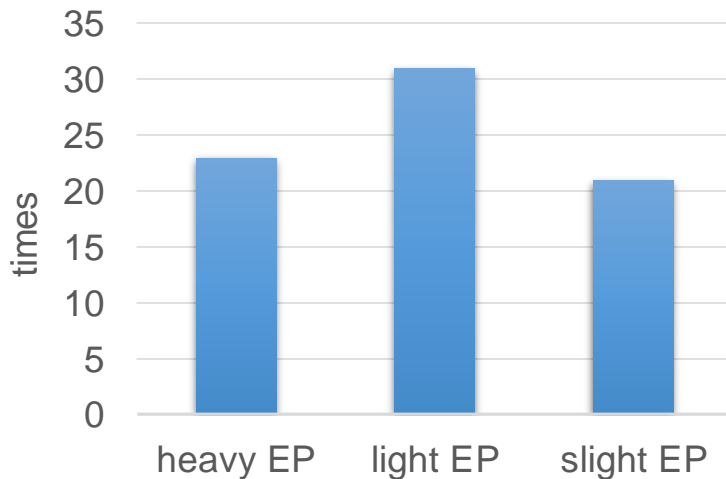
- The recipe exploit
- Cavity routinely treatments
- System upgrading and performance potential studying
- Maintaining and Optimization for industrial procedure

# Study on the recipes of EP

- Familiar with standards EP procedures
  - Heavy and light EP
- Exploited a recipe, that can be suitable for IHEP facility
  - Electro-chemistry parameter, as voltage, temperature, etc.
  - Acid mixing
  - On-site cleaning
- Attempt cold EP
  - High stable power supply was ordered
  - Low temperature commissioning
- Procedures before and after EP

# Routinely EP for 1.3GHz cavities

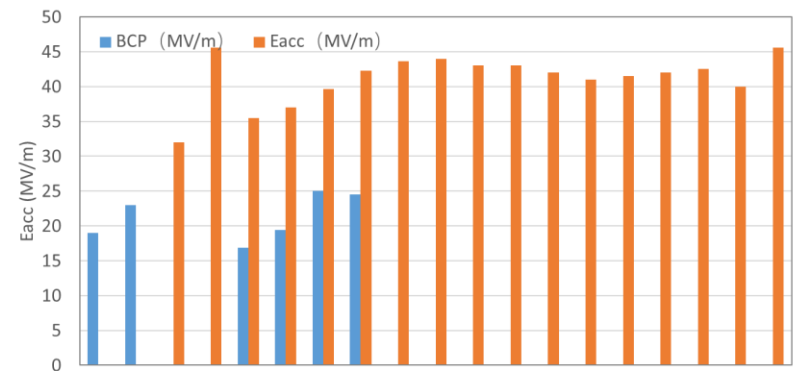
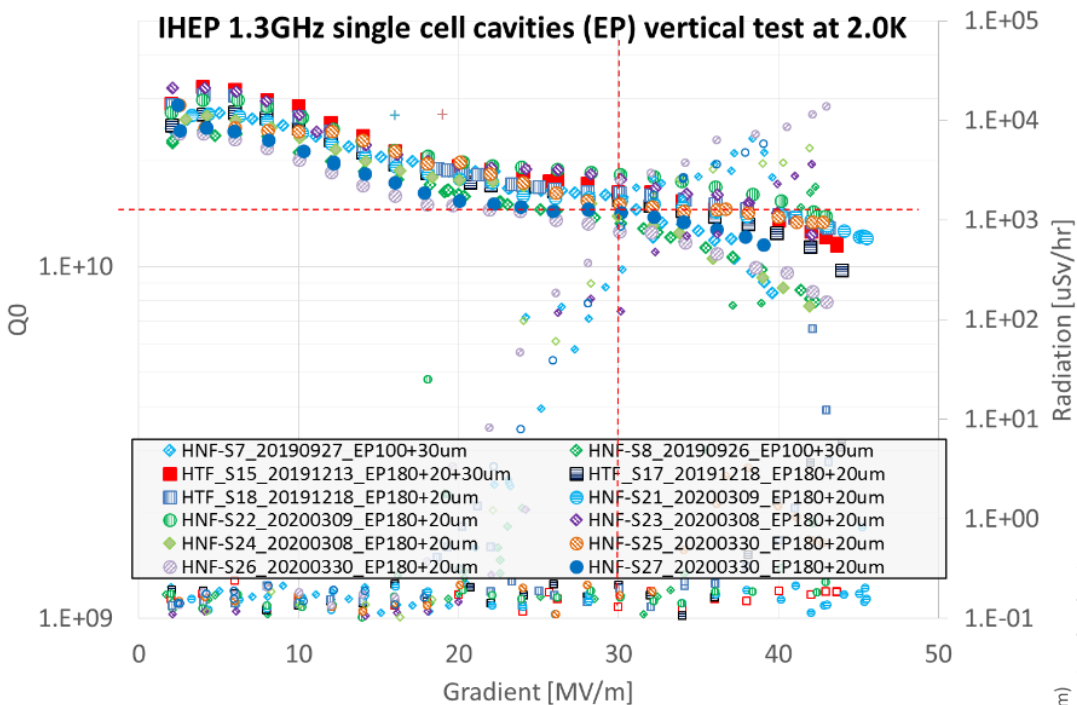
- Heavy EP, More than 100  $\mu\text{m}$
- Light EP, Due to the R&D, various removal thickness are needed. Around 10~100  $\mu\text{m}$ .
- Slight EP. Use Cold EP, less than 10 $\mu\text{m}$ .
- For EP itself and high Q study, totally **about 75 times EP were done**
- Besides there are several tens of EP by a simple EP setup, which can only treat 1-cell cavity at Ningxia company.



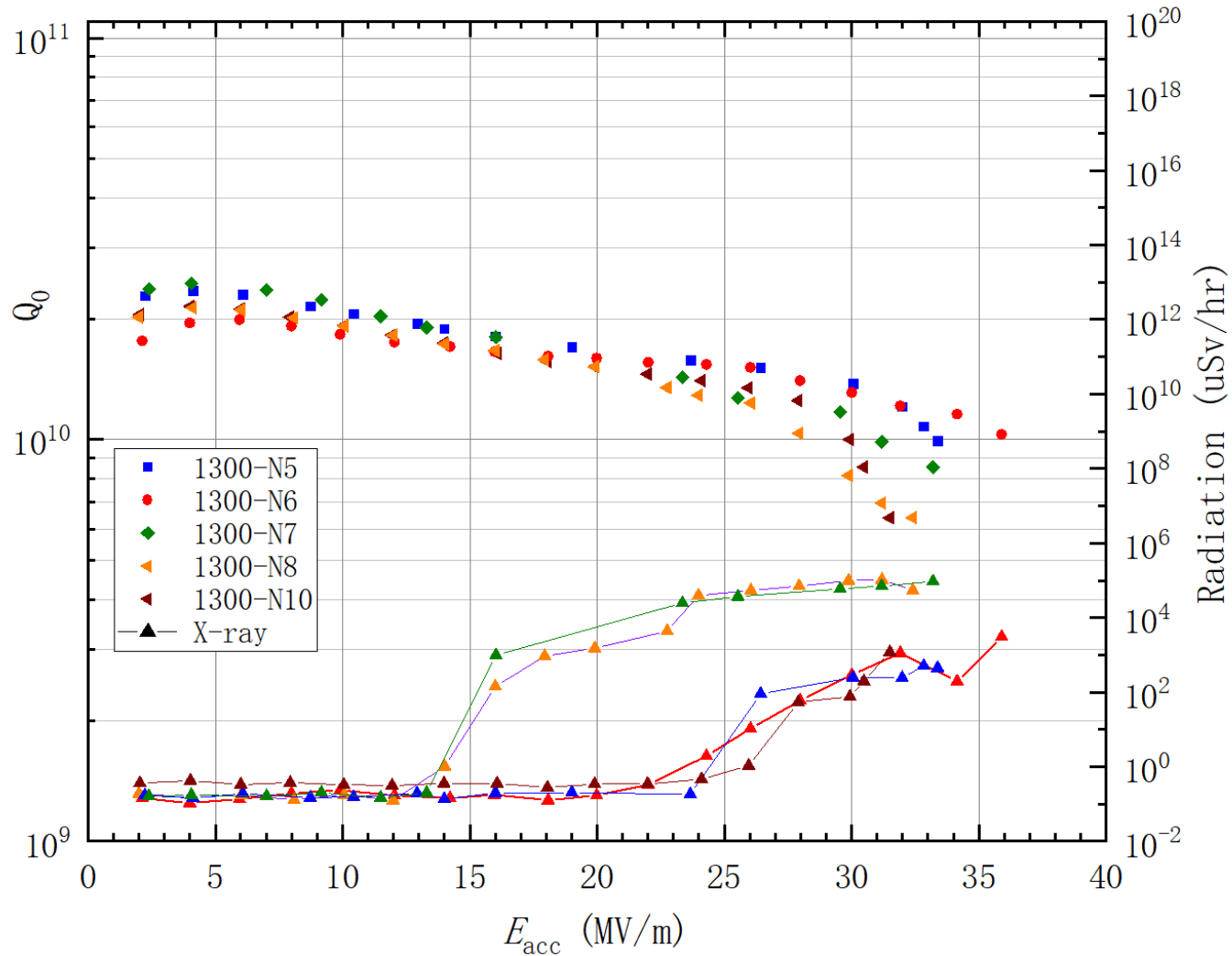
EP vs etching. May be the higher the better.

# Vertical test results- 1.3GHz 1-cell cavity

- All 12 single-cell cavities > 40 MV/m. Max 46 MV/m.

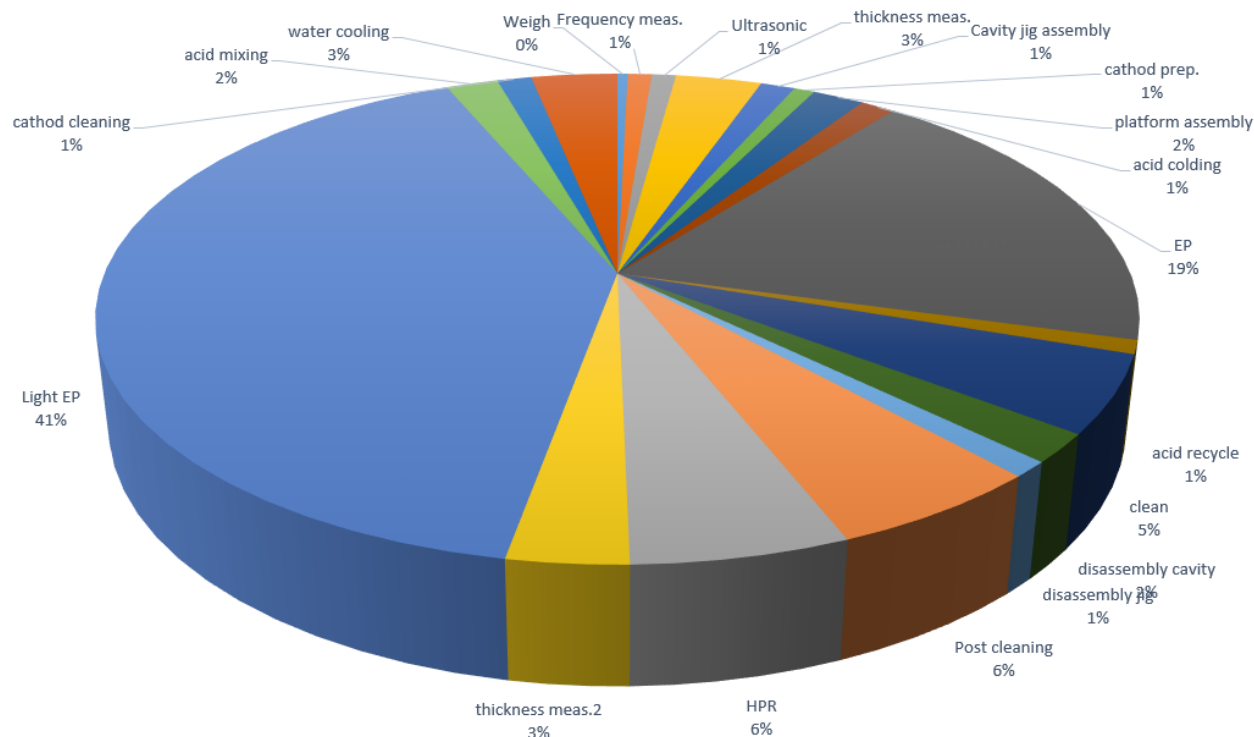


# Vertical test results- 9cell cavities



# Time distribution for a cavity EP

- For a conventional EP, a whole process including both heavy and light EP seems to take more than 70 hours.
- So, if there is some new recipes which can slim the processes and increase the efficiency, it will seem to be greatly attractive.



# Acid control

- In this EP system, new acid and old acid are separated.
- New acid is for fresh EP, while old acid for heavy EP.
- However, waste acid dispose is very expensive.
- So, a program was wrote use excel to monitor and control the acid to avoid unnecessary waste.

数字代表：酸如果用是第几次使用			抛光前容器状态		抛光溶液去向					抛光后容器状态	
日期	腔	EP量 (μm)	MT混酸 1代表新配	BIT主存储	MBT主缓存 用溶液	MT或BIT是否 排空 (1为空)	第几次 使用	MBT去向	排废	MT混酸 容器	BIT主存储 容器
20191229	S21	180		3	BIT		3	BIT			4
20191230	S20	20	1	4	MT		1	MT		2	4
20191231	S22	180	2	4	BIT		4	BIT		2	5
20200102	S16	9	2	5	MT	1	2	MBT		0	5



# Upgrading

- The EP system were upgrading several times for increasing the capability or resolve some problems.
- Sept.14<sup>th</sup>, 2019, 14 days, upgrading for acid lever auto-control, and 1-cell temperature control scheme 1.
- Dec.12, 2019, 20 days, a set of new special 9cell cavity jig was tried to assemble. New air conditioners were assembled in three room for temperature control. 1-cell temperature control scheme-2 was tried.
- April 4<sup>th</sup>, 2020, 25days. 9cell mechanical and solution system commissioning and recipe study for the first time. On-line cleaning functions were upgraded for 9-cell.
- May 15<sup>th</sup>, 2020, 9days. Piping cleaning and modification. Temperature control scheme-3 made by IHEP and company, and work well.

# Maintaining

- The system has worked for near half and a year. Several components, such as sensors, membrane pumps, sealings began to have problems.
- A booklet is now underway to record for routine maintenance.
- Several kinds of components were ordered for backups
- And knowledge for main components characteristics, as pumps, sensors, material and so on, accumulated.

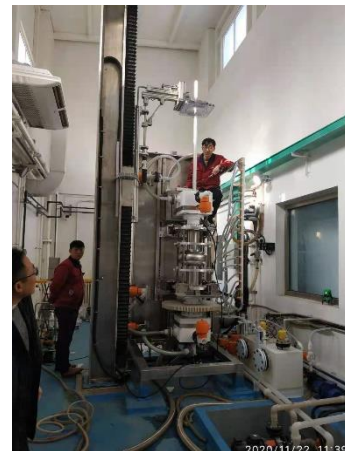
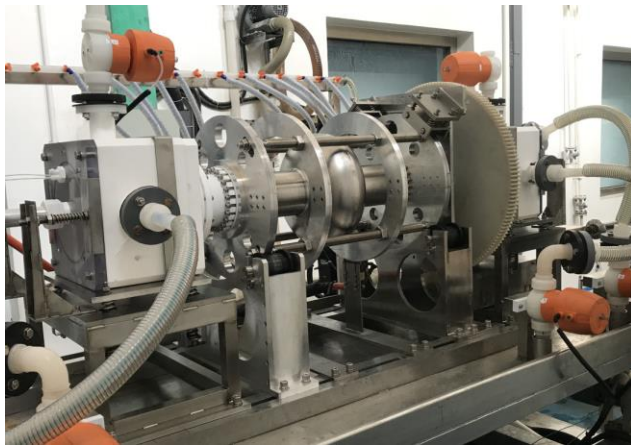


# Towards to industrialization

- Two full-time workers from IHEP factory were send to Ningxia
  - For daily EP treatments
  - Attending upgrading and commissioning
- Operation management, three levels:
  - Account manager
  - Recipe developer
  - Operator
    - Recipe is gradually frozen.
    - Parameter will be imbedded and fixed to the control system.
    - Procedure will be simplified to operation.

# Current status and next

- At present, 650MHz 1-cell cavity EP system is under commissioning.
  - Hardware upgrading were finished by two companies in mechanical and solution aspects.
  - The water commissioning is finished. Several new problems like rotation sleeves leaking, were resolved.
  - Now, we are under acid commissioning
  - Then, we start recipe study and two 650MHz 1-cell cavities will be treated.
- In the future, it will also used for 500MHz cavities.



**Thanks for your attentions !**